VEGETABLE SUBSTANCES

USED FOR

THE FOOD OF MAN

VOL. I.

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ADVERTISEMENT.

THE substance of the present Work was published in the volumes of the Library of Entertaining Knowledge, under the name of "Vegetable Substances used for the Food of Man." Since the period of their publication, the progress of organic chemistry has been so rapid, and the relations subsisting between the vegetable and animal kingdoms have become so much more fully elucidated, that it was found necessary, before republication, to submit the whole of the present work to a careful revision, and much of it has been rewritten. The Editor, in doing this, has consulted the labours of Mülder, Liebig, Playfair, Dumas, and Boussingault, and has arranged the various substances treated of according to a chemical classification. It is hoped that this plan will not only facilitate the perusal of the work, but also render the practical application of the results of recent chemical discoveries more obvious. In most cases, where the composition of the vegetable substances spoken of is given, the most recent chemical analyses have been consulted. In some cases, however, where no analysis has been made by chemists

of the present day, those which appeared in the original edition of the work have been allowed to remain. Little or no alteration has been made in the general views upon the great question of the relation of the supply of food to the prosperity and happiness of man in civilised communities. The views laid down in the previous work have become gradually extended, and their soundness is now acknowledged by those who once opposed them. It is not too much to hope, that at the present moment, when a large portion of the food of the inhabitants of this country is threatened with destruction, and that the produce of other countries is about to be brought in larger quantities to our shores, this work may be the means of drawing attention to the real nature of the food of man, and the relative advantage of its various kinds for the purposes of life.

London, March 6, 1846.

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SCOTTISH PUBLIC LIBRARY

THE FOOD OF [illegible]

INTRODUCTION.

The culture of the earth is a pursuit which in itself offers a sufficient distinction, not only between man and the inferior orders of animated creation, but also between man while in his merely animal state, and after he has become humanized by adopting the arts of civilization. It is this pursuit which must, in fact, precede, and be made the foundation for all other useful and ennobling occupations,—the spring whence must flow, certainly, the greater part of those reciprocal duties and affections which at once form society, and render it the source of enjoyments. That man who first, among a tribe of hunters or fishers, sows a grain or plants a root, and thus brings home the advantages of forethought to the "business and the bosoms" of his less provident fellows, becomes their benefactor, not merely by pointing out the means for avoiding the horrors of famine, and for lessening that succession of miseries which must attend upon a life of wandering, but also, by relieving their minds from the selfish exigencies that previously attended every moment, affording thereby leisure and opportunity for cultivating the social and kindly affections. It is not until men have placed themselves beyond that stage of merely physical existence wherein the plenty of to-day may be followed by the destitution of to-morrow, that the higher faculties and feelings of our nature can be expanded. It must certainly, therefore, be matter of more than common interest to obtain some knowledge of those vegetable substances through

the cultivation of which man has been enabled to localize himself, to rest, and to store up harvests; and by thus becoming freed from an incessant call upon his physical energies for the supply of his necessities, to acquire the motives and the means for becoming something higher and better in the scale of being.

Vegetables form the primary source of sustenance to everything that lives. Were the earth without them and bare—and but for cultivation, how much of it would be in that state—the effects of heat and cold, of drought and rain, would be so violent, that, apart from all considerations as to food, the whole world would speedily become uninhabitable. Frosts and drought would break, and the returning water would wash away, the surface, until the whole would become one wide and swampy waste. The presence of vegetation prevents this pulverulating action, and converts what otherwise would be destructive agents into ministers of abundance. No vegetable productions tend so much to bring about this beneficial result as those which are cultivated for human food. By the shade which they afford to the ground in the hot season, they check that evaporation, and prevent that excessive hardening of the surface, which in an exposed wild render the soil impervious and inert; while, on the other hand, the humidity which they imbibe during the rainy season is again given out by continual and gradual evaporation, and they minister to the refreshment and the productiveness of all around them. In countries which are uncultivated the weather is mostly in extremes. Rain, when it comes, takes the form of an overwhelming flood, not gently entering into and moistening the soil, but rushing along the surface, tearing up one place, strewing another with the *débris*, and reducing both to a state of indiscriminate ruin; while scarcely has the flood gone by, when the returning heat evaporates the little moisture which is left behind, and burns up the coarse and scanty vegetation which the rains had fostered.

These effects of the unmitigated action of the elements are most strongly marked in those parts of the world

where hitherto the seasons have defied the labour of man, and have seemed to wage war upon his agriculture. This is the case in some parts of India, in Southern Africa, and in a great part of what we yet know of Australia, where at one time the earth is parched up, and the beds of rivers become dry channels or unconnected pools, while at another they suddenly pour onward to the sea in a wide-spreading inundation, or rob their rapid floods in narrow but deepened channels. That the labours of cultivation exert the most beneficial effect upon climate may be shown by contrasting the waste and uncultivated parts of our own country with other parts in the same latitude, and at the same elevation above the level of the sea, but which are in a state of high cultivation. In these, while the immediate object of providing a certain and abundant supply of food has been accomplished by the labours of man, an indirect influence has been exerted scarcely less beneficial, by rendering the country in general more healthy and agreeable.

In the central parts of Scotland, where the introduction of agricultural improvements has been much more recent than in England, but where, owing to causes whose investigation would be misplaced in these pages, their progress has been much more rapid, the change of climate has fully kept pace with those improvements. It is within the experience of persons still living, to have noticed that the snow, which in that country formerly began to fall in November, was not wholly gone until the month of April; while in the middle of summer the heat was so excessive that agricultural labourers were obliged to suspend their toil during four or five hours in the middle of the day. At that time the autumnal rains frequently descended with so much violence that the crops, which had been retarded by the coldness of the spring, were prevented from ripening on the high grounds, were lodged and rotted on lands that were lower, and swept away by the swelling of the streams over the holms and meadows. In the same spots, at the present day, the quantity of snow which usually falls

during the winter is comparatively small, appears rarely before Christmas, and is gone in February, or early in March. The summer heat is more uniformly distributed, seldom amounting to a degree oppressive to the labourer, or protracted to a term injurious to the crops; while the rain which follows is neither so violent in degree nor so long continued, and happening when the grain is far advanced towards ripeness, the injury which it does is comparatively trifling.

This mitigation of the seasons, which is wholly referable to the progress of cultivation, has had the happiest effect upon the health of the inhabitants. Diseases which formerly paid their periodical visits with distressing regularity, have either been wholly put to flight —have been deprived of the terrors in which they were clothed: the supply of food, which rested upon contingencies beyond control or calculation, has been secured with a comparative certainty; and famines, which commonly recurred at periods only a few years apart, are now happily unknown, except in some of the very wildest districts, and then only at very distant intervals.

We propose, as far as can be accomplished within narrow limits, to trace the progress of our own country towards one of the chief objects and indications of civilization—that of obtaining an abundance and a variety of wholesome and agreeable vegetable food at the cheapest rate and with unfailing regularity for increasing inhabitants. This great object is principally accomplished by the natural progress of a people in knowledge and industry. It is advanced by good commercial laws; it is retarded by bad. But if the general laws of a country have the effect of rendering industry free and property secure, it will go forward without the assistance of governments, and in spite of that assistance, too often misdirected—an embarrassment instead of a help. As we trace this advance of civilization, we first find that famines, once the unfailing scourges of a country, occur at longer and longer intervals, till at last they disappear altogether. We next perceive that seasons of scarcity producing much severe misery, though not to be com-

pared in their desolating effects to famines, become also fewer and fewer. Lastly, we discover that, though the great necessary of life, bread, may be dearer in one year than in another, the fluctuations in price are seldom extreme and never sudden. If we investigate the causes of these remarkable circumstances, which always attend a very advanced state of society, we shall find that they are not be ascribed to the vigilance of the soundest legislation, or to the provident foresight of the wisest ministers; but to the spirit of commerce, pursuing its natural course without interference from the cumbrous aid of a government, or the opposing prejudices of a people. When a nation has become accustomed to the best food, instead of habitually resorting to the lowest, which it can only do by its steady but certain progress in industry and a taste for comforts; when the intercourse between all parts of a country is certain and rapid; when large capitals may be safely and profitably employed in storing corn in seasons of abundance to meet the exigencies of a season of scarcity; when such vegetable productions of other lands as will endure to be naturalized can be grown in plenty at every man's door; and, lastly, when foreign commerce places the natural productions of every country within our reach in exchange for our own natural productions—then, and not till then, can a nation be said to be so advanced in civilization as to have secured, as far as possible, a constant supply of the best vegetable food that the earth can furnish, at a price accessible to the great mass of consumers.

The particular circumstances which advance or retard this desirable end will be (as far as may be done without touching upon disputable points) brought out in the following pages. The general subject will embrace a history of the vegetable food of our people, as dependent upon agriculture, gardening, commerce; and that history will be illustrated by notices of the food of other great bodies of mankind. The subject will necessarily involve a few details of vegetable physiology, and of practical agriculture and horticulture; but it

must be evident that any scientific description of the structure of plants, however interesting, would be as much out of place here as any minute accounts of farming and gardening processes. Our desire is to excite attention to some of those ordinary circumstances in the condition of mankind which have such powerful effects upon the advance of the world in knowledge and happiness. In this point of view, a blade of wheat, a potato, or a peppercorn, may each be made a theme to direct the attention to some of the most important causes of the prosperity of nations; and the result of such observation and inquiry must necessarily be a conviction that all human interests are strictly allied, and that the great mutual necessities which bind mankind together are steadily going forward to break down the barriers which separate classes and nations, and to diffuse knowledge, and plenty, the fruit of knowledge, over all the earth.

In the study, then, of this subject, all who are engaged in the culture of the soil, whether the wealthy proprietor who draws from his estates a lordly revenue, the farmer who earns from his fields an independent subsistence, or the peasant whose toil obtains from the little nook which joins his cottage a wholesome meal for his family, may draw from the pursuit the means of mental improvement. Those, too, whose callings or professions shut them out from the contemplation of rural objects, may derive both pleasure and advantage from knowing by what care a grain of wheat is elaborated into the material of a loaf of bread, and how that loaf is supplied with regularity both at seed-time and at harvest. Lastly, each and all may, with equal profit, acquire some information concerning that almost countless number of foreign productions which commerce has brought to form a part of the daily food and comfort of almost the humblest of our fellow-citizens. Does it not, in fact, appear natural, it might almost be said inevitable, that every one should feel an interest in prosecuting inquiries as to things to which he is indebted for so many of his daily comforts and enjoyments — how they are produced, whence they are brought, and by what exer-

tions their appearance at his board has been accomplished?

It is not entirely in relation to their uses that a knowledge of vegetable productions will be attempted to be conveyed in the following pages. Circumstances attend the growth of many even among the plants most familiar to us, which need only to be observed to ensure our admiration, and these will be incidentally pointed out. The seed of a globe-turnip is exceedingly minute, not larger perhaps than the twentieth part of an inch in diameter; and yet in the course of a few short months this seed will be elaborated by the soil and the atmosphere into a solid bulb of matter, containing, in some cases, twenty-seven millions of times the bulk of the seed, and this in addition to a considerable bunch of leaves. We cannot, in any case, indeed, open a page in the great volume of Nature that is not calculated to excite our highest admiration; that, if read aright, must not incite us onward to the study of her works; or which can fail to raise our grateful hearts towards the Supreme Author of every good.

CHAPTER I.

GENERAL CONSIDERATIONS ON THE NATURE OF VEGETABLE FOOD.

Before entering on the consideration of particular plants yielding the food of man, we shall endeavour to give our readers some idea of the ultimate composition of the parts of plants used as food, and of the functions they perform in the animal system. When the chemist analyses the structure of plants or animals, he finds that the elementary matters of which they are composed are nearly all identical, there being only a few elements which have been found exclusively in either the animal or vegetable kingdom. Chemists enumerate fifty-five elements, not more than a third of which have been found present in animals and plants, and four only of these are found constantly present in organic bodies. These four are carbon, hydrogen, oxygen, and nitrogen, and from their constituting so large a proportion of organised bodies, they are sometimes called *organic elements*. However varied may be the forms, colours, smell, and taste of the vegetable kingdom, or diversified the structure or functions of the animal kingdom, their great bulk is composed of these four elements. As instances, however, of the presence of other elements, we may mention that the oxides of potassium and sodium (potash and soda) are frequently present in plants, and that phosphate of lime constitutes a very important ingredient in the bones of all animals. Although the *inorganic elements*, as those bodies which do not universally enter into the structure of plants and animals are called, do not exist in large quantities, they nevertheless perform an important part in the functions of the tissues, into the

composition of which they enter. It is, however, to the organic elements to which we wish now more particularly to draw attention.

Although carbon, hydrogen, oxygen, and nitrogen exist in the tissues of the animal as well as those of the plant, we have no evidence at all that would lead us to suppose that these elements are supplied to it from any other source than the vegetable kingdom. The whole material, in fact, of which an animal is composed, is derived from substances formed in the tissue of vegetables, so that wherever we have an animal, we have the expression of the fact of the previous existence of vegetable beings. The plant does not, however, supply the animal with carbon, hydrogen, oxygen, and nitrogen in a simple state, but in the form of various secretions of the vegetable tissue, which enter into the food of man and other animals. These secretions are known to chemists by the names of gluten, fibrine, albumen, casein, &c.; nor does the plant derive its food from the organic elements in a pure form, but in a state of combination the one with the other. The great sources of material for vegetable nutrition are—*carbonic acid gas*, consisting of carbon and oxygen; *water*, composed of oxygen and hydrogen; and *ammonia*, a compound of hydrogen and nitrogen. It is from these principles, which are abundantly found in nature (and formed in the various kinds of manures that man supplies the plant with which he grows for food), that the plant elaborates the various secretions that are used by the animal kingdom as aliment.

The various secretions of plants that enter into the food of man not only subserve the purpose of building up the fabric of his body, giving particle for particle of the daily waste that is going on in the body through muscular exertion and the processes of secretion, but they also supply materials for keeping up the animal heat of the body. When a thermometer is applied to the body of a man, it will indicate a temperature of 98°; and this though the external temperature be zero. This animal heat is essential to the processes of life going on in the body,

and requires to be kept up at the proper temperature; and we find that this is effected in the animal system just in the same way that we artificially produce heat in our fires and lamps, *i. e.* a certain quantity of vegetable matter containing carbon and hydrogen is brought in contact with oxygen, with which it unites, and the consequence is the liberation of heat. Now it is found that the secretions of plants which contribute to the development of animal heat differ materially in their composition from those which assist in the building up of the animal machine. The former are characterised by possessing carbon, hydrogen, and oxygen, but no nitrogen; whilst the latter are distinguished by possessing this element, in addition to the other three. As carbon is the most conspicuous ingredient in the first class of secretions, they are called *carbonaceous;* they have also been called, from the function they perform in the system, *respiratory* or *combustible* secretions. The latter class, containing nitrogen, are called *nitrogenous* or *azotised*, and, in allusion to their special use in the nutrition of the body, *nutritious* secretions.

The nitrogenous secretions are found abundantly deposited in the various parts of plants which are used by man and animals as food. It is only recently that they have been detected by chemists, and their discovery has abolished a distinction which was formerly supposed to exist between plants and animals by the tissues of the latter exclusively possessing nitrogen. The various secretions containing nitrogen are all modifications to a greater or less extent of a principle called, by its discoverer Mulder, *protein*, from the Greek word πρωτεύω ("I am first.") It has the following composition:—

Nitrogen	5
Oxygen	12
Hydrogen	31
Carbon	40

This substance is the basis of three other principles, called *albumen*, *fibrine*, and *casein*. These three last have long been known as the principal constituents of

animal bodies, but it is only recently that their existence has been demonstrated in most of those parts of plants which are used as food by man and animals.

Albumen is found in many parts of animals; it is known familiarly as constituting the white of eggs, and is found in most of the animal fluids that assist in the nutrition of the body. It exists in many vegetables, as in the cauliflower, asparagus, mangel-wurzel, turnips, &c., the clarified juice of which, when boiled, yields a coagulum in its chemical composition and physical characters precisely similar to the white of eggs. Albumen is soluble in water, and is found in a state of solution in the serum of the blood of all animals, and in the juices of the vegetables in which it exists. When, however, it has been submitted to the action of heat, or certain chemical preparations, as acids, it coagulates and becomes incapable of solution in water again. It differs from protein in containing two atoms of sulphur and one of phosphorus, in addition to the elements of which that compound is formed.

Fibrine enters more largely into the fabric of the animal body than albumen. It is found in the blood, the lymph, and the chyle, as well as in the juices of plants in a dissolved form. In the muscles, and in fruits, seeds, &c., it is seen in a coagulated form. It is distinguished from albumen and other substances by its spontaneous coagulation, by its not being soluble in water, alcohol, or ether, and by its being precipitated from acid solutions by ferrocyanide and ferridcyanide of potassium. Fibrine differs from albumen in possessing but one atom of sulphur. It is, however, readily convertible into albumen, as is seen in animals fed entirely on animal food (muscular tissue containing fibrine), which contain albumen in their blood. On the other hand, albumen, as during the development of the egg, passes readily into fibrine. The substance in plants formerly called *gluten*, and which abounds in the Cerealia, as in the flour of wheat, barley, oats &c., is identical with fibrine.

Casein exists in the milk of all the Mammalia, and is the substance which is separated from this fluid in the

form of cheese. It is found abundantly in some vegetables, and especially in the seeds of the Leguminosæ, as beans, peas, &c. It differs in composition from the two last substances by the absence of phosphorus. It may be converted into albumen; and thus, although it is found in no other fluids of the body but the milk, and not in the solids at all, it can be used by the system for all the purposes of nutrition in the same manner as the other nitrogenous secretions. It may be distinguished from albumen by its not coagulating at the temperature of 167°, as also by its being precipitated from its solutions by all weak acids, and re-dissolved in them by an excess.

We thus see that although these three substances are yielded by different groups of plants, and differ somewhat in their chemical composition and physical characters, they perform the same function in the economy of man, and for practical purposes may be regarded as possessing the same dietetical virtues.

The *second* class, the *carbonaceous* secretions, have been well known to chemists for a length of time. The most important of them are—*starch*, *sugar*, and *oil*.

Starch is found abundantly in the tissues of almost all plants, existing in the form of small irregularly shaped granules, which are of different sizes and forms according to the plants in which it exists. Its composition is as follows:

Carbon . . .	12
Hydrogen . . .	10
Oxygen . . .	10

In various plants it exhibits a slightly different chemical composition, and somewhat different physical characters; and chemists have described substances having all the dietetical properties of common starch, such as is obtained from the tubers of the potato, the fruit of wheat, &c., under the name of lichen-starch and inculine. Starch is separated from some plants used as an article of diet, under the names of arrow-root, tapioca, sago, wheat-starch, potato-starch, &c.

Sugar is found in the sap of many plants, and is sepa-

rated for the purposes of diet from the sugar-cane, beet-root, maple, the cocoa-nut and jaggary palms, the grape, &c. It is found also in the animal kingdom, forming a part of the milk of all the species of Mammalia. It has a composition resembling starch, and, when taken into the animal system acts in the same way as starch. It is, however, more readily digestible: and it is probably on this account that it is supplied in the milk as the combustible or respirable element in the food of the young of the class Mammalia. It has been observed, that men and animals fed on sugar and starch get fat: and Liebig has drawn attention to the fact that the fat must be produced by a change in the chemical constitution of these substances, by which they are converted into oil. This conclusion of Liebig was at one time doubted by Dumas and the French chemists, but recent experiments have led to the confirmation of Liebig's conclusion. This is a fact of great practical importance, as persons may be living on food which will cause them to get fat, and yet receive no real nourishment for the tissues that contain nitrogen.

Oils are of two kinds, *fixed* and *volatile*, and both are found in the vegetable kingdom. The former only, constitute any large amount of the food of man; the latter are found extensively, giving the various scents and tastes to plants, and are only taken in the food of animals in small quantities. Various seeds yield oil, as the cocoa-nut, almond, rape-seed, and poppy-seed, from all of which it is often separated. It has, however, been observed to be very generally present in plants, and it was from this source alone that Dumas supposed animals were supplied with the oil which forms the fat of their bodies. Oil of fat, a substance which may be regarded as the basis or representative of all fixed oils, has a composition of—

Carbon . . .	11
Hydrogen . . .	10
Oxygen . . .	1

In consequence of the large quantity of hydrogen it contains in addition to its carbon, it is a more inflammable

body than either sugar or starch, and is therefore more capable of keeping up animal heat. It enters into the diet of man in many of the seeds which he eats, as also in the form of butter and in fat meat, and the various dishes prepared from it. On account of its power of maintaining combustion, it is eaten largely by persons inhabiting the colder and more northern parts of the world.

Although we have not referred to animal food, it will be seen from what we have said, that the flesh, that is, the muscles, bloodvessels, nerves, and other parts, are formed out of the nitrogenous secretions of plants, and it is by feeding on the flesh of other animals that some depend for their subsistence, as the whole of the Carnivora. Man's digestive organs, structure, and habits adapt him for feeding on animals, and we find that animal food enters more or less into his diet throughout the whole world. The nitrogenous matters which he thus obtains must, however, be first procured by some animal from the vegetable kingdom, as the animal does not possess the power of forming in its own body these substances.

Amongst the secretions of vegetables which are used by man in his food, there are some which do not appear to serve materially either in building up the fabric of his body or in maintaining heat in his frame. These have been called *medicinal secretions*,* because they seem supplied rather to protect the frame from falling into disease than to contribute to any of the great functions of life. Examples of such substances are seen in the *organic* ACIDS, which enter into the composition of the juices of most fruits; the *volatile oils*, which form the principal feature of our various spices; and the *alkaloids*, which are consumed in the form of tea, coffee, chocolate, and Paraguay tea.

In the following chapters the various substances used as food by man will be arranged according to the outline here presented to the reader. It would be quite

* See Lankester's 'Lectures on the Natural History of Plants yielding Food.'

impossible to give an accurate chemical arrangement of foods, but each plant will here be spoken of as it yields a larger quantity of one or other of the secretions which contribute to the nourishing, heating, or healing the human body.

CHAPTER II.

PLANTS YIELDING NUTRITIOUS SECRETIONS.

THE CEREALIA.

THE modifications of the chemical substances protein, albumen, fibrine or gluten, and casein, are found in all plants yielding a substantive food for man. They are, however, found in the greatest abundance in the seeds of the various forms of corn-plants, as wheat, barley, maize, &c., and particularly of the Leguminosæ. Gluten is found in the former and casein in the latter. The more digestible properties of gluten or fibrine have caused the plants which contain it to be used more extensively as a diet by mankind than any other. The seeds however, of none of these plants yield these nutritious secretions alone. In all cases they contain starch, and also varying proportions of water. The following analyses will indicate the nature of the secretions contained in the seeds of some of the corn-plants and Leguminosæ :-

100 lbs. contain	Water and ashes	Nitrogenous secretions.	Carbonaceous secretions.
Wheat	7	23	70
Barley	17	14	69
Oats	20	11	69
Rice	11	3	86
Maize	12	7	81
Peas	19	29	52
Beans	17	31	52
Lentils	19	33	48

The first five mentioned in this list belong to the Cerealia, to which also belong the millet and rye.

The corn-plants are all annuals, both in their stems

and roots, the whole plant dying after the seed has fully formed and ripened, and sometimes even before the latter process has been perfectly accomplished. They all send up a straw or culm, which is hollow, and divided into lengths by nodes or joints; and at these joints the leaves have their insertion, one at each joint, on the alternate sides of the stem; each leaf embraces the stem for some length in the manner of a sheath. It is worthy of remark that these stems always contain a portion of silex, or earth of flint, in a state of very minute division—from which circumstance their ashes are found useful in imparting a polish to articles formed of wood, horn, ivory, or some of the softer metals; while, on the other hand, the presence of this material, and the great difficulty attending its separation from the purely vegetable matter, have always offered obstacles to the employment of straw for the manufacture of paper.

The last leaf of the season performs the office of a sheath to the newly formed flower, embracing it for a time so firmly that the sheath cannot be opened without difficulty. With the growth of the flower it bursts open its protecting spatha or sheath, rises above it, and the leaf then turns backward.

The head or ear consists of an uncertain number of flowers, followed by seeds. These are sometimes placed upon a single rib or *rachis*, as in wheat and barley, and they then form a spike. In the variety called Egyptian wheat this spike is compound, there being more than one rachis; if this consists of branches that are naked at their points of junction, and have spikelets at their extremities, they form what is called a panicle: this is the case, for example, with oats.

The chief corn-plants, or Cerealia, are wheat, rye, barley, oats, millet, rice, and maize. The tribe of cereal grasses is not restricted to these seven genera, but includes numerous others, which, if they are not equally employed as food, are neglected only on account of the smallness of their seeds. "None are unwholesome in their natural state, with the single exception of *Lolium temulentum* (darnel), a common weed in many parts of

England, the effects of which are undoubtedly deleterious, although perhaps much exaggerated. In this respect an approach seems to be naturally made to the properties of half-putrid wheat, which are known to be dangerous."*

The presence of the corn-plants in any region of the earth attests that man is there in an advanced stage of civilization. In the sepulchres of the Egyptian kings, which were opened by the naturalists and other scientific persons who accompanied the French army to Egypt, was found the common wheat, in vessels which were so perfectly closed that the grains retained both their form and their colour.† The wheat, buried there for several thousand years, was a proof of the ancient civilization of Egypt, as convincing as the ruins of temples and the inscriptions of obelisks. The corn-plants, such as they are found under cultivation, do not grow wild in any part of the earth. Wheat has been traced, indeed, in Persia, springing up in spots very remote from human habitation, and out of the line of the traffic of the natives; but this circumstance is far from proving that it is a production natural and indigenous to Persia. In Sicily there is a wild grass called *Ægilops ovata*, which is found in particular districts. It has been held that the seeds of this plant may be changed into corn by cultivation; and that the ancient worship of Ceres, which considered the fields of Enna and of Trinacria as the cradles of agriculture, had its origin in this transformation of the native grass. Professor Latapie, of Bordeaux, affirms, that having cultivated the seed of the *Ægilops*, the plant has changed its generic character, and has made approaches to that of wheat.‡ Sir Joseph Banks, in a paper addressed by him to the Horticultural Society, in the year 1805, stated that having received from a lady some packets of seeds, and among them one labelled "Hill Wheat," the grains of which were hardly larger

* Lindley's 'Introduction to the Natural System of Botany,' p. 302.

† See Lyell's 'Geology,' vol. ii. p. 81.

‡ 'Dict. Classique d'Histoire Nat.,' art. 'Ægilops.'

than those of our wild grasses, but which, when viewed through a magnifying lens, were found exactly to resemble wheat, he sowed these grains in his garden, and was much surprised on obtaining, as their produce, a good crop of spring wheat, the grains of which were of the ordinary size. Every inquiry that was made to ascertain the history of these seeds proved fruitless. All that could be established, with regard to the place of their production, was, that they came from India; but as to the particular locality, or the amount of cultivation they had received, or whether the grain was indeed in that instance a spontaneous offering of nature, could not be ascertained. More recently experiments have been performed which have led Dr. Weissenborn, in Germany, and some observers in this country, to believe that plants of oats may be converted into rye, and *vice versâ*. This is the more singular, as it occurs in plants which are regarded by botanists as generically distinct.* Experiments such as those we have mentioned may naturally lead us to think that in the corn-plants, as in other vegetables, great modifications have been produced by cultivation; but they do not at all interfere with the belief that the cereal grains are spread through the earth by the agency of man alone, and that they are bequests from past ages of civilization too remote to afford any materials for the authentic history of their introduction, even into countries possessing the most ancient records. Other seeds are dispersed throughout the earth by winds and currents, in the hairy coats of quadrupeds, and in the maws of birds. But the corn-plants, in common with many other important vegetable productions, follow the course of man alone. This is a blessing, which even hostile armies are instruments in diffusing. Cortez, the conqueror of Mexico, inhuman as he was in many parts of his conduct, thus writes from Mexico to the king of Spain:—"All the plants of Spain thrive admirably in this land. We shall not proceed here as we have done in the isles, where we have neglected cultivation, and

* 'Gardener's Chronicle,' Aug. 1844.

destroyed the inhabitants. A sad experience ought to render us more prudent. I beseech your Majesty to give orders that no vessel set sail for this country without a certain quantity of plants and grain." The diffusion of plants useful to man is an accident diminishing the evils of hostile invasion;—it is a necessary attendant of commercial intercourse. The Indians of New England called the plantain "Englishman's foot;" and in the same way, in the infancy of ancient society, wheat might have been similarly regarded as springing from the footsteps of the Persians or the Egyptians. In times approaching nearer to our own we know that wheat followed the march of the Romans, as the vine was in the train of the Greeks; and, to come still nearer, we find cotton remaining in countries which had otherwise suffered from the incursions of the Arabs. "The migration of these plants," observes Humboldt, "is evident; but their first country is as little known as that of the different races of men which, from the earliest traditions, have been found in all parts of the globe."[1]

The manner in which the most important gifts of Providence to mankind have been diffused by the influences of conquest or commerce, has some striking instances in the history of America. In the New World such facts are too recent to admit of any doubt. The same class of facts, too, are exhibited in several cases in the history of our empire in Hindustan. We shall give a few examples.

None of the cereal grasses, properly so called, were found in cultivation among the Mexicans when their country was first visited by Europeans. The foundation of the wheat-harvests at Mexico is said to have been three or four grains which a slave of Cortez discovered, in 1530, accidentally mixed with a quantity of rice. The careful negro who preserved and made so advantageous a use of the few grains which a happy chance had thrown in his way, and which, in the hands of a careless or thoughtless person, would, with their future

[1] 'Géographie des Plantes,' p. 35.

inestimable advantages, have been lost to his country, has not been thought worthy, doubtless because he was a negro, of having his name preserved. The Spanish lady Maria d'Escobar, wife of Diego de Chaves, who first imparted the same blessing to Peru, by conveying a few grains of wheat to Lima, has been more fortunate. Her name, together with the means which she took for effecting her object, by carefully distributing the produce of successive harvests as seed among the farmers, have been gratefully preserved in the records of history. The exact period when this cultivation was commenced in Peru is not, indeed, known; but it appears reasonable to believe that this event did not occur until after the date assigned for the introduction of wheat into Mexico as in the year 1547 wheaten bread was hardly known in the important city of Cuzco. The first grains of wheat which reached Quito were conveyed thither by Father Josse Rixi, a Fleming, who sowed them near the monastery of St. Francis, where the monks still preserve and show, as a precious relic, the rude earthen pot wherein the seeds first reached their establishment. The rice of Carolina is now the principal produce of that portion of North America. Mr. Ashby, an English merchant, at the close of the seventeenth century, sent a hundredweight from China to this colony; and from this source all the subsequent rice-harvests of that division of the New World, and the large exportations of the same valuable grain to Europe, have sprang. The wheat now cultivated in Rohilcund, in India, "was propagated by seed brought from England, since the conquest, by Mr. Hawkins;"* and the potato, within very years, has been extensively spread by us through the Indian peninsula, and there, by preventing the exclusive use of rice, is greatly ameliorating the condition of the native population. Facts such as these are highly interesting, because they exhibit the moral as well as natural causes which influence the distribution of vegetable food throughout the earth. In the following

* Heber's 'Journey,' vol ii. p. 131.

pages we shall endeavour to collect whatever is satisfactorily known as to this branch of our subject. Before we proceed, however, to a particular history of species or varieties of vegetable substances used for the sustenance of man, we shall take a rapid though necessarily imperfect view of the distribution of the corn-plants throughout the globe at the present day.

Agriculture can be pursued but very partially within the northern polar circles, where, for the most part, the intenseness of the frosts during a protracted winter binds up the soil, not otherwise sterile, and condemns it to perpetual unfruitfulness.

The utmost limit of the culture of grain in Siberia reaches only to the sixtieth degree of latitude, and in the more eastern parts of the province these important products are scarcely to be met with higher than fifty-five degrees. In the more southern parts of Siberia and in districts adjoining the Wolga the land is extraordinarily fertile, so that crops of grain are obtained with a very trifling amount of labour. Buck-wheat is very commonly cultivated in this district; and it is found that one sowing of the seed will produce five or six crops in as many successive years, each harvest yielding from twelve to fifteen times the quantity first sown. The seed which is shed during the reaping is sufficient to ensure the growth of plants for the following year, without any manuring, and with no more labour on the part of the farmer than that of harrowing the land in the spring. This system is continued without intermission until the diminished fertility of the soil compels its abandonment; but, as already mentioned, this state of things rarely occurs until six years have been thus occupied.

It might be thought that in a country thus fertile the proprietors or cultivators of the soil would speedily become enriched; this, however, is by no means the case. Facilities for transporting their surplus produce are wretchedly deficient, so that the market is extremely circumscribed; and the inhabitants of the country being

generally so poor as to be unable to purchase food produced from grain, the farmers limit their cultivation in a great degree to the quantity needed for the supply of their own families. The small amount of labour called for by this cultivation is usually performed by the farmer himself, assisted by the members of his own family; the employment of any other farm-labourers is consequently rare.

All temptation to extend the breadth of culture must be wanting in a situation where the surplus produce cannot be exchanged, and its value invested in some permanent mode, whereby a larger quantum of human labour may be commanded at any future period.

Europe is indebted to Siberia for a particular description of oats, which are considered excellent; and at Yakutsk barley is sometimes seen to arrive at maturity.

In some districts of Lapland, situated to the westward, the inhabitants are, by dint of careful tillage, enabled to produce plentiful crops of rye. In some spots, nearer even than this to the pole, potatoes are made to supply the place of grain; but for the most part the inhabitants are constrained to subsist upon dried fish.

In Kamtchatka, which is considerably to the south of Siberia, extending from 62° to 51° of north latitude, but united with that province at its eastern extremity, no attempts to cultivate the cereal grasses have ever proved successful, the produce not having in any case been sufficient to repay the labour of the tillage. These failures may, however, be attributable more to the generally ungrateful nature of the soil than to the effects of an unkindly climate, since in some spots where the land is of better quality other esculent vegetables are produced in tolerable perfection; cabbages, carrots, turnips, radishes, beet-root, and even cucumbers, are raised constantly and without difficulty. Dried fish and caviaire form the principal food of the inhabitants of Kamtchatka and the islands of the Aleutian Archipelago.

Barley and oats are the kinds of grain the culture of which extends farthest to the north in Europe. The meal which they yield, and which is seldom or never

used by the inhabitants of South Britain for human food, forms, on the contrary, the principal sustenance of the inhabitants of Norway and Sweden, of a part of Siberia, and even of Scotland.

Rye follows next in order, being associated with oats and barley in the more northern division of the temperate zone. In the southern parts of Norway and Sweden, in Denmark, in districts bordering on the Baltic Sea, and in the north of Germany, rye forms the principal object of cultivation; barley being raised in those countries, as with us, only for the purpose of brewing, and the use of oats being limited principally to the feeding of horses. In all these last-mentioned places wheat is also grown; but its consumption is limited, and the principal part is made an object of external trade.

The winters of Norway are intensely cold, but their summers are, on the contrary, excessively warm, particularly in the valleys, upon which the rays of the sun are reverberated during the day from the mountains, while the atmosphere has no time for becoming cool during the few hours when the sun is below the horizon. In such situations, barley is generally sown and reaped within the short space of sixty days; sometimes even six weeks are found to suffice for fulfilling the hopes of the husbandman. The Norwegian agriculturist is, however, occasionally visited by seasons throughout which the sun appears to lose its genial power, and vegetation is stunted; blossoms, indeed, appear, but are unsucceeded by fruits, and the straw yields nothing but empty ears. This calamity is happily of rare occurrence; and, unless when checked by a premature frost, the harvests of Norway are for the most part abundant and excellent.

Agriculture is pursued systematically and even scientifically in Sweden, by which means the prevailing barrenness of the soil is partially remedied. The province of Gothland is made to produce barley, oats, rye, and wheat, as well as peas and beans. In these climates the transition of the seasons is always abrupt. Vegetation, when it has once commenced, proceeds with a rapidity unknown in these more temperate regions, and

the interval which elapses between committing the seed to the soil and gathering the ripened harvest is scarcely greater in Sweden than is experienced in Norway.

Somewhat farther to the south, rye in a great measure disappears, and wheat becomes the principal material used for human food. France, England, the southern part of Scotland, part of Germany and Hungary, and the lands of Western and Middle Asia, fall within this description. In most of these countries the vine is also successfully cultivated; and wine forming a substitute for beer, the raising of barley is consequently much neglected.

Still farther southward wheat is found in abundance, but maize and rice are also produced, and enter largely among the constituents of human food. Portugal and Spain, that part of France which borders on the Mediterranean Sea, Italy, and Greece, are thus circumstanced.

Still farther to the east, in Persia and Northern India, Arabia, Nubia, Egypt, and Barbary, wheat is indeed found; but maize, rice, and millet form the principal materials for human sustenance. On the plains near the Caspian Sea, in the province of Georgia, rice, wheat, barley, and millet are raised abundantly, and with very little culture. In the more elevated parts of those districts rye is sometimes cultivated, but oats entirely disappear, the mules and horses being fed on barley.

The mode of culture followed at the present day in Egypt is exceedingly simple, and calls but for a small amount of labour. All that is required for raising barley and wheat is, when the inundations of the Nile have subsided, to throw the seed upon the mud: if this should be thought too hard and stiff, the grain is lightly ploughed in, and no farther care or culture is then required until the ripening of the produce, which usually happens from the beginning to the end of April.

In Nubia, and particularly above the Great Cataract, the banks of the river are so high as seldom to admit of the overflowing of the waters, and the Nubian cultivators are consequently obliged to employ *sakies*, or

water-wheels, for the purpose of irrigating the fields during the summer: this practice prevails as far as Sennaar. Each of these sakies is capable of irrigating as much land as is calculated to yield from twelve to fifteen hundred English bushels of grain, and employs the alternate labour of eight or ten cows. The water thus dispensed over the land is thrown up either from the Nile, or from pits dug to the depth of fifteen or twenty feet, in which an abundant supply is soon collected. The principal vegetable productions of Nubia are barley and *dhoorra* (Sorghum, or Indian millet). The use of wheat is confined to the more wealthy inhabitants.

The grains which form the principal objects of cultivation in our division of the globe are rarely seen in China and Japan, where rice greatly predominates. The reason for this is not to be sought in the influence of climate, but rather in the peculiar manners and tastes of the people; since, throughout the isles of Japan, and in a very considerable part of the Chinese empire, every one of those grains might be successfully reared. The denseness of population in China furnishes a sufficient reason why the pursuit of agriculture should be so much encouraged as it is by the government. The annals of that singular people acquaint us, that one of their emperors who enjoyed the highest reputation for wisdom was taken from the plough to sit upon the throne. Another has been celebrated for having discovered the art of draining low lands, of collecting the water in canals, and of converting it from a noxious impediment to the useful purpose of irrigation. Their emperor Ven-ti, who reigned 179 years before Christ, is said to have incited his subjects to the more zealous cultivation of their lands, by ploughing with his own hands the land surrounding his palace, which example being followed by his ministers and courtiers, influenced in turn those who moved in a less exalted sphere.*

* Du Halde, 'Nouvelle Relation de la Chine,' tome i. pp. 274-5.

Of the countries which lie between the tropics, those of Asia adopt principally the use of rice, while maize is made the common food of the Americans. There exists a natural reason for this distribution, Asia being undoubtedly the native region of rice, while maize is as certainly the production of America. In Africa, except as already particularized, and in the British settlements of that continent, the two grains are used indifferently and in nearly equal proportions.

Wheat is found in some situations within the tropics; but its high price, as compared with that of other grains, occasions its use to be confined to the more wealthy classes. In many parts of British India, and particularly in the upper provinces, the quality of the wheat is represented as being excellent, although the grain is smaller than with us. Barley is likewise grown in some of the more northern districts, but the grain does not attain to the same size or plumpness as in Europe. The variety cultivated in India is that known by us under the name of Bigg: its cheapness causes it, however, to be extensively used by the native population, who eat it in the form of cakes.

The agriculture of the Hindu Ryots is of the very rudest description: their ploughs are scarcely deserving of the name, having no contrivance for turning over the soil; the instrument employed as a harrow is nothing more than the branch of a tree, or, at best, is only a wooden frame, sixteen or eighteen feet long, in the form of a ladder, which is drawn by four oxen, and driven by two men, who add to its effectiveness by standing upon the instrument. Dr. Buchanan, in the account of his 'Journey through Mysore, Canara, and Malabar,' closes a very disparaging account of Indian husbandry with the following remarks:—

"'I am afraid, however, that the reader, in perusing the foregoing accounts, will have formed an opinion of the native agriculture still more favourable than it deserves. I have been obliged to use the English words ploughings, weedings, and hoeings, to express operations somewhat similar that are performed by the natives;

and the frequent repetitions of these, mentioned in the accounts taken from the cultivators, might induce the reader to imagine that the ground was well wrought, and kept remarkably clean. Quite the reverse, however, is the truth. Owing to the extreme imperfection of their implements, and want of strength in their cattle, a field, after six or eight ploughings, has numerous small bushes remaining as upright in it as before the labour, while the plough has not penetrated above three inches deep. The plough has neither coulter nor mould-board to divide and to turn over the soil, and the handle gives the ploughman very little power to command its direction. The other instruments are equally imperfect, and are more rudely formed than it was possible for my draughtsman to represent."*

The only circumstance which is stated favourable to the agricultural skill of the Hindus, is the existence of contrivances for irrigating the lands in seasons of drought. This process is effected by means of tanks, which are maintained under the compulsory regulations of the governments, whose revenues depend upon the produce of the soil.

It remains to trace the distribution of the Cerealia throughout America. The highest limit for the cultivation of these plants on that vast continent is in the more southern portion of the Russian possessions, situated between 57° and 58° of north latitude, where barley and rye are brought to maturity. On the more eastern coast of America, the same cultivation rarely succeeds higher than 50° or 51°.

In the United States, wheat and rye grow as in the more temperate regions in Europe; and it is perhaps owing to faulty methods of tillage, occasioned by the great abundance of land and the dearness of labour, that the produce bears a small proportion when compared with that obtained from cultivating the same extent of land in Europe. Great improvements in this respect have already been introduced; and when population

* Vol. i. p. 126.

shall be found, as in older settled countries, pressing against the means of subsistence, there is no reason why the lands should not be made as productive generally, as they are in the carefully-cultivated districts of this country. Maize is very extensively raised in the United States, and in the southern parts of the Union rice is also very largely cultivated.

Canada produces wheat in sufficient abundance to supply its own population, and to make large occasional shipments to the mother-country, where this produce is received upon more advantageous terms as regards the duty payable on importation, than wheat, the produce of any part of the continent of Europe. In proportion as the lands of Canada are cleared of their timber, we may expect that a larger amount of grain will be spared by that province for consumption in Europe; unless the tide of emigration should continue to set more and more strongly towards that quarter, so as to call for a proportionately increased quantity of grain for the sustenance of the settlers.

Humboldt, in his account of New Spain, has given a very interesting view of the agriculture of South America. In the lower latitudes of the Mexican republic, the cereal grains of Europe, comprehending under this denomination wheat, barley, oats, and rye, are never cultivated at a lower elevation than from 2500 to 3000 feet above the level of the sea. It is well known that the habitation of plants is determined, in a very decided manner, by the elevation of different regions. On this subject De Candolle calculates, that in France every five hundred and forty feet of vertical elevation is equivalent to a receding of one degree from the equator; while Humboldt estimates every rise of three hundred and ninety-six feet to be equal to the same advance to the north, in tropical countries. We know that the summits of the towering Andes—some of which are placed almost directly under the equatorial line—are yet covered with perpetual snow; and that in many mountainous countries within the tropics, the seeds and fruits of temperate regions are seen to flourish.

On the declivity of the Cordilleras, between Vera Cruz and Acapulco, wheat cultivation does not in general commence at a lower level than 4000 feet. Sometimes, as in the immediate vicinity of the city of Xalapa, wheat is sown, not for the sake of the grain, which indeed it there never produces, but because the straw and succulent leaves furnish excellent fodder for cattle.

It does not appear, however, that the degree of latitude and the amount of elevation are the only circumstances that determine the fructification of wheat, since in Guatemala, which is nearer to the equator, and at a much lower level than Xalapa, that grain comes to full perfection. Humboldt offers, as reasons for this variance from the usual rule, the exposed situation of the district, and the prevalence of cool winds, which serve to modify the otherwise unfavourable influence of the climate. "I have seen," says this observant traveller, "in the province of Caraccas, the finest harvests of wheat near Victoria (latitude 10° 13′), at 500 or 600 metres (1640 or 1968 feet) of absolute elevation; and it appears that the wheat-fields which surround the *Quatro Villas*, in the island of Cuba (latitude 21° 58′), have still a smaller elevation. At the Isle of France (latitude 20° 10′) wheat is cultivated on a soil almost level with the ocean."*

Circumstances altogether unconnected with climate must be taken into account in determining the relative agricultural capabilities of Mexico, where the absolute absence of rain, throughout a large portion of the time when the plant is on the ground, must be in a high degree detrimental to wheat husbandry, unless artificial means were resorted to, as in Nubia, for supplying the natural deficiency of moisture. Throughout a great part of the temperate regions of New Spain the farmers are compelled to adopt the system of artificial irrigation. This is effected by the agency of canals and reservoirs, which are supplied from the rivers, and which are so

* Humboldt's 'New Spain,' p. 454.

constructed that the water may be dispensed at pleasure over any and every part of the farms.

In districts where the system of artificial watering is fully adopted, the fertility of the Mexican farms is extraordinary,—far beyond anything experienced in the richest soils of Europe, the wheat harvest being commonly thirty-five and forty for one, and some considerable estates yielding even fifty and sixty measures for one measure of seed. In similar localities, and with land of equal quality, but where no opportunity has been provided for watering the fields, the annual return does not exceed more than fifteen or twenty for one.

Maize is also very extensively cultivated in Mexico; and, from the genial nature of the climate, and the general fertility of the soil, the returns which it yields to the farmer are most abundant. Humboldt informs us that in the valley of Mexico the maize harvest yields two hundred for one. The Indians and Mestizoes, who form a large proportion of the inhabitants of the republic, feed on maize and manihot (cassava), the consumption of wheat being principally confined to the white inhabitants of the towns.

In the temperate and polar districts of the southern hemisphere, the order of cultivation is very similar to that pursued in similar latitudes and elevations north of the tropics. In America wheat is commonly found in the southern provinces of Brazil, in Buenos Ayres, and in Chili. The same grain predominates at the Cape of Good Hope, the flour which it yields being of beautiful quality, and accompanied by less than the usual proportion of bran. In Australia wheat also forms the principal object of cultivation on the part of the settlers; but, in the southernmost portions of that vast island—which, perhaps, it were more correct to call a continent—and in Van Diemen's Land, barley and rye are likewise to be found.

CHAPTER III.

WHEAT.

By common consent, and in every climate where it can be cultivated, Wheat is held in the highest estimation of all the cereal grains. The cost of its production, compared with that of some other substantive articles of aliment, does, indeed, occasion it to be but little consumed in countries where the bulk of the inhabitants are constrained by poverty to subsist upon the cheapest description of food that will sustain life. Where, however, the people are in a situation which enables them to indulge their choice in respect of food, wheaten bread, with scarcely an exception, constitutes the chief material for consumption.

Grain of Wheat, upper and under sides.

A full-grown and perfect grain of wheat will, on examination, be found to resemble the above figures. In form it is a compressed oval, and is inclosed firstly in certain chaffy scales, which are readily to be separated from it, and secondly in a membranous tunic, which invests the seed much more closely. Along that side of the grain which, while the plant was growing, was turned towards the rachis, a groove may be observed. At the base, on the opposite or convex side, is to be seen a small protuberant oval space, which indicates the germ or embryo of the future plant, and which is at this time covered by the tunics. The vessels whereby the

grain was attached to the plant, and through which it drew nourishment until its maturity, had their point of attachment at the basal termination of this protuberance. When the seed is perfectly ripe, the umbilical vessels separate; the point of separation speedily heals in the same manner as a portion of a deciduous tree from which a matured leaf has detached itself, and the grain may then be easily threshed out from the chaff in which it had lain buried; sometimes, indeed, it sheds itself spontaneously.

Several species, and a still greater number of varieties, of wheat are to be found. Many of these differences are doubtless to be referred to influences of climate and modes of culture. The genus *Triticum*, to which wheat is referred by botanists, is known by possessing solitary spikelets with the glumes two-valved and many-flowered; the valves carinate, acute, or mucronate; the palea two-valved; the valves lanceolate; the external one acuminate, the internal one bifid at the extremity. The genus consists of about forty species; of these sixteen are European, and only five are natives of Great Britain. The species are divided into two groups,—the *cerealia*, yielding edible fruits, and the *agropyra*, which are merely grasses. The latter group is by some writers, as Beauvois and Lindley, made into a distinct genus. It includes all the species that are natives of Great Britain.

The cerealia are known by their spikelets being more or less ventricose and turgid, and the valves are ovate or oblong. These are again divided into the *Frumenta* or true wheats, in which the seeds fall out from the chaff, and the *Speltæ* or spelts, in which the seeds remain attached to the chaff. The most important species belonging to the former division are the following:—

T. vulgare, common wheat, has a four-cornered imbricated spike, with four-flowered spikelets, the valves ventricose, ovate, truncate, mucronate, compressed under the apex, the nerve somewhat prominent. This species includes the *T. æstivum* and *T. hybernum* of many bo-

tanists. They appear, however, to be only varieties of this species differing in their periods of growth.

The native country of this species, is not well ascertained; it has been found wild in some districts of Persia, also of Siberia, apparently removed from the influence of cultivation. The great extent to which the cultivation of this species has been carried in Europe has produced many varieties. Metzger, in his 'Getreide Arten,' describes eighteen varieties which are cultivated in Germany, and many more might be added to this. The variety called *T. æstivum* is the type of all the wheats which are called summer and spring wheats. These wheats are not much cultivated in Great Britain; they are, however, in some parts of Germany. Metzger recommends the white-beard summer wheat to be grown on poor lands, as it yields the best straw for plaiting, which is used extensively in Italy for this purpose. *T. æstivum* is supposed to be a native of Siberia, in the land of the Beschkirs. It is less hardy than the winter-sown kind, and the whole plant has a weaker appearance: the stem is thin and delicate, the ear more slender and less erect, and it is provided with much longer beards or awns. This description of grain, which in our uncertain climate cannot be safely or productively cultivated throughout the kingdom, is yet domesticated in the more southerly and midland districts. As its grain is smaller than that of the commoner sort, and as its produce is less abundant, the farmer would not be led to its cultivation could he be certain of success with earlier sown seed, or if in the progress of his agricultural operations the land could always be got ready for the autumnal sowing.

The principal advantage to be derived from the adoption of summer wheat consists in the security which it offers against the injurious effects of a cold and rainy spring; so that in situations and seasons where winter-sown wheat is so far injured as to destroy all prospect of a harvest, this delicate but more rapidly growing species may be more confidently depended on for yielding its in-

Ear and Plant of Spring Wheat.

crease. Some farmers, when they perceive that the seed they have sown in the autumn fails and goes off in patches from any untoward causes, are accustomed to rake spring wheat into the vacant spaces, and wherever the plants appear weak and thin. By this means the uniformity of the crop is restored; and, if the operation has not been delayed beyond the beginning of April, the spring wheat will be matured and ready for the sickle at the same time with the earlier sown plants. This mixture of grain is of no consequence to the miller, but it would be manifestly improper to employ the produce as seed. When the spring wheat is sown by itself, the season for this operation is in April or the early part of May, from which time onward the farmer has but little to dread from any severity of weather in the above-mentioned districts. It is said that this species of wheat is

not subject to blights. According to the analysis of Sir Humphry Davy, the nutritive quality of this kind is not quite equal to that of the winter wheat, the proportions being 92½ per cent. in the latter and only 91 per cent. in the former, of the entire bulk of the grains. The gluten contained in two kinds varies in a greater degree, that of winter wheat being 24, while that of spring-sown corn is only 19, so that the winter variety is most eligible for the purpose of the baker.

T. hybernum is the Lammas or winter wheat, and embraces by far the greater number of varieties which are cultivated as the food of man. The wheats known in Great Britain and on the Continent as Fox, Kentish, Talavera, and Bohemian, or velvet, red, white, red-eared, and bearded wheats are varieties of *T. hybernum*. This species may be easily distinguished by its appearance, being much more vigorous in the stem, more erect and thick in the ear, and, in comparison with the other, destitute of beard or awn, for which reason its bloom is more conspicuous. The same cause may be cited to account for the fact that its pollen is both more easily diffused and more liable to be destroyed. This plant is sown in autumn, stands through the winter, and ripens its seed in the following summer. Slight varieties of this species are exceedingly common in different localities, and are probably attributable to some peculiarities in the mode of culture; and the common varieties of winter wheat are distinguished from each other according to the colour of the tunic enveloping the grain, and the difference observable in their chaff. The colours are usually divided into white and red, the latter of these including many different shades of brown. Red wheat is commonly said to be more hardy than white; it is therefore thought to be better suited for cultivation in bleak

ductive as the white, and the flour which it yields is seldom of so desirable a quality.

The cultivation of another description of wheat, called from the form of the ear the duck-bill or conical wheat, *T. turgidum*, has been attempted in England, but

without any profitable result, having no qualities that recommend it to the agriculturist. About ten varieties of this species are known to the agriculturist, half of which are summer and half winter wheats; of these the Russian or blue English wheat and the bread-wheat are the best.

T. durum — true beard wheat, has the prominent carinæ of the last wheat, with the valves ventricose oblong, and three times longer than broad. It is a native of Switzerland, and has several varieties, all of which produce summer wheats, and are better known in Italy, Sicily and Spain, than in this country.

T. compositum Egyptian or many-spiked wheat, called also the corn of abundance, is principally cultivated in the country whose name it bears, and in Italy.

Ear and Plant of Winter Wheat (*T. hybernum*).

Ear and Plant of Duck-bill Wheat (*T. turgidum*).

It is probably a native of the north of Africa, and resembles spring wheat more than any other description. The ear is bearded, and the grains are thinner than those of winter wheat. It is the distinctive character of this plant that its rachis is branched so that the ear is made up of several spikelets. Egyptian wheat will bear great degrees of heat and drought without injury, so that it is found to yield abundantly in situations where other kinds would be greatly injured if not destroyed—a circumstance which points it out as admirably adapted to the arid lands whereon it is chiefly cultivated.

T. polonicum, Polish wheat, has the spike irregularly four-cornered and compressed; the spikelets three-flowered; the valves subventricose, oblong, lanceolate, herbaceous, with many nerves; it is found native in some

parts of Europe, not, however, in the country which gives it its name. In cultivation it yields summer wheats, which are adapted for warmer climates than Great Britain. It was partially cultivated in England in the latter part of the seventeenth century, but is now to be found only in botanic gardens.

The spelts include the following species:—

Triticum spelta, which is imagined to be the *Triticum* of the Romans and the *Zea* of the Greeks, although this latter name has been given to Maize, a grain unknown to the ancients. This species has a parallel compressed spike loosely imbricated, a fragile rachis, spikelets 4-flowered, the valves obliquely truncated, dentato-mucronate, the carinæ compressed, strongly prominent above, with the tooth of the apex inflexed. All the

Ear and Plant of Egyptian or many-spiked Wheat (*T. compositum*).

Ear and Plant of Polish Wheat (*T. polonicum*)

species of spelts are cultivated extensively in Germany, and there is so strong a prejudice in their favour in the markets of the south of Germany that other kinds of corn can with difficulty be got rid of. Their great advantage appears to be that they accommodate themselves to almost any kind of soil, yielding good crops in all degrees of moistness and dryness. They possess a firm stiff straw, which is not easily laid, and are not attacked by birds, and are less liable to smut. It is said that spelt wheat is better adapted than any of the more delicate kinds for culture in Australia, and probably it would be found the preferable sort in all the more southern wheat-growing countries.

There are two distinct varieties of spelt, distinguished as the awned and the awnless; the latter is perhaps the

most naked of all the cerealia. The grains of this are large, but the ear contains only a small number of them, as a portion of the flowers prove barren. It is generally, if not always, a spring-sown crop, grows strongly, and its stalks are nearly solid. Bread made of its flour is said to be of a dry quality.

T. dicoccum, two-grained, or rice-wheat, has the spike oppositely compressed, rachis fragile, the spikelets 4-flowered, the valves obliquely truncated, dentato-mucronate; the carina compressed, strongly prominent above, with the tooth of the apex inflexed. This is the *T. amyleum* of some authors, and is cultivated with the other spelts in Germany.

T. monococcum, one-grained wheat, or St. Peter's corn, has 3-flowered spikelets, the valves at the apex

Ear and Plant of Spelt Wheat (*T.*)

Ear and Plant of One-seeded Wheat (*T. monococcum*).

2-toothed, with straight acute teeth at the apex of the carina. This species is frequently cultivated in Switzerland, and containing less gluten than common sorts, it answers better for being boiled into gruel than for being baked into bread. The four-sided form of the ripe ear is so extremely regular, that it has the appearance of being carved in ivory. The straw, which is both hard and firm, is excellent for thatching.

The well-known method of propagating wheat is by sowing the grain in land previously prepared for its reception by ploughing. It has been held that this important preliminary of pulverizing the soil can hardly be carried to excess, the expense attending it forming almost the only limit to its prosecution. Cato the Censor, who, in addition to his accomplishments as a warrior and a

statesman, showed an intimate acquaintance with rural economy, has recorded his opinion on the necessity of thoroughly turning up the soil. In his treatise, '*De Re rustica*,' he has laid it down as the first rule in husbandry to plough well, and the second rule—to plough.*

Two distinct practices are followed in committing the seed to the earth. The most ancient and most commonly used of these is that of scattering the seed from the hand of the sower over the whole surface; and this is characteristically called sowing *broad-cast*. The other method, which is comparatively of modern introduction, is that of depositing the seed in holes formed in straight furrows, and at regular intervals, which is called *drilling*, or dibbling; while the processes which accompany it, and which are impracticable with the broad-cast method, are distinguished as the horse-hoeing or drill system of husbandry.

Lord Bacon says that in his time (the beginning of the seventeenth century) attempts had been made to plant wheat, but that the plan was abandoned, although undoubtedly advantageous, as involving too much labour.† In 1660 Evelyn furnished to the Royal Society a description of a sowing machine, invented by Locatelli, an Italian, who had obtained a patent for its use in Spain, having proved its utility by public experiment.‡ The drill plough was, however, not used in England, and was perhaps quite unknown to a body of men who are proverbially slow all over the world to adopt any improvement till public attention was awakened to it in the early part of the last century, by the celebrated Jethro Tull, who, after practically following for some years his own improved plan of husbandry, and thereby proving its advantages, published a particular account of his process in the year 1733. This work, which he entitled 'An Essay on Horse-hoeing Husbandry,' became highly popular, compelling the attention of English agriculturists to the subject, and engaging no less the consideration of

* Cap. xi. † Sylva Sylvarum.

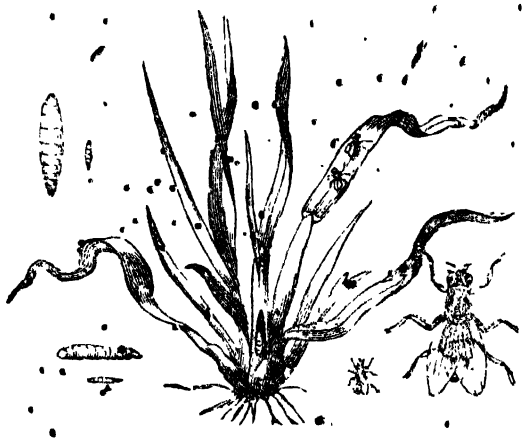
‡ See Beckmann's 'History of Inventions,' vol. iv. p. 45, ed. 1817.

scientific foreigners. The system of Mr. Tull consisted in discarding the old method of scattering seed upon the land broad-cast, and in substituting a mode of sowing the grain in straight rows or furrows by means of an implement more perfect than Locatelli's machine, which delivered the seed at proper interval, and in the exact quantity that was found most beneficial. Spaces of fifty inches' breadth were left between the furrows, so that the land could be ploughed or horse-hoed in these intervals at various periods during the growth of the crop, the object of these hoeings being to bring fresh portions of the soil into contact with the fibrous roots of the plants, and thus to render every part in turn available for their nutrition. One material advantage that results from the new method of husbandry is the saving which it occasions in seed-corn, and which is said to amount to five-eighths of the quantity usually expended in the old method. The comparative merits of the two plans have for so long a time been submitted to the surest of all tests, that of experience, and have been so well examined by competent persons, who have given the result of their inquiries to the world, that it cannot be necessary to do more in this place than refer the reader to those authors for farther information.

The manner in which plants are produced through the germination of seeds is so well known, that in any community where the human mind has been advanced in that degree which incites to the cultivation of the earth, it would perhaps be difficult to find a man so insensible to the workings of nature by which he is surrounded, as not to have noticed with admiration the phenomena accompanying the development of vegetable fecundity. It is true, we know not how this standing miracle is brought about; and, in all human probability, we never shall be able to pierce the veil wherein the inciting energy is shrouded to which that fecundity is owing; but is it possible for us, while conscious that it exists, not to be grateful for the benevolence whereby that energy is ceaselessly called into action? At one end of the groove, in a grain of wheat, is a small protuberance, as we have

already mentioned, which is the germ or embryo of the future plant. This organ has been appropriately called *corculum* (little heart). It contains within itself a principle, which, if rightly managed, is capable of evolving not only a plant of wheat, with its abundant spike, but also plant after plant, and spike after spike, until, in the course of a few harvests, the progeny of this little germ would become capable of feeding a nation. Thus it is, that in the lapse of ages, amidst the desolations of rude conquerors, and the alternations which the finest portions of the earth have endured from civilization to semi-barbarism, the vital principle of vegetable life destined for the chief support of the human race has not been lost; and it has remained to man, like fire, which he alone of all animals has subjected to his use, to be called forth at his bidding to administer to his support, his comfort, and his advance in every art of social existence.

The number of stalks thrown up by one grain of wheat is indefinite, and depends upon local causes. This power of multiplication, as possessed by the grain-bearing plants, is called *tillering*. In its progress the stalks do not rise immediately from the germ, but are thrown out from different points of the infant sprouts while yet they remain in contact with the moist soil. An increase of the cereal plants, by this means, is sometimes produced beyond anything conceivable by those persons who have not attended to the fact. But for it, the casualties to which these important plants are liable during the earlier stages of vegetation, would in many cases operate fatally to the hopes of the farmer. One or two circumstances may be mentioned in which this power of multiplying themselves at the roots is of the highest advantage in the cultivation of the cereal grains. An insect—*musca pumilionis*—is accustomed to deposit its eggs in the very core of the *plumule* or primary shoot of wheat, so that it is completely destroyed by the larvæ. Did the plant possess within itself no means of repairing this injury, the whole previous labour of the husbandman would in this case have been in vain. But this destruction occurring in the spring of the year, when the vege-



Wheat-fly (*Musca pumilionis*), in its different stages.

tative power of the plant is in the greatest activity, an effect is produced somewhat analogous to that of heading down a fruit-tree; shoots immediately spring up from the nodes (knots), the plant becomes more firmly rooted, and produces, probably, a dozen stems and ears where, but for the temporary mischief, it might have sent forth only one.

Several extraordinary facts have been recorded in connection with the inherent power of multiplication possessed by these vegetables. Among others, Sir Kenelm Digby asserted, in 1660, that "there was in the possession of the Fathers of the Christian doctrine at Paris, a plant of barley which they at that time kept as a curiosity, and which consisted of two hundred and forty-nine stalks springing from one root or grain, and in which they counted above eighteen thousand grains or seeds of barley." In the 'Philosophical Transactions'* it is

* Vol. lxiii.

recorded, that Mr. C. Miller of Cambridge, the son of the eminent horticulturist, sowed, on the 2nd of June, a few grains of common red wheat, one of the plants from which had tillered so much that on the 8th of August he was enabled to divide it into eighteen plants, all of which were placed separately in the ground. In the course of September and October so many of these plants had again multiplied their stalks that the number of plants which were separately set out to stand the winter was sixty-seven. With the first growth of the spring the tillering again went forward, so that at the end of March and beginning of April a farther division was made, and the number of plants now amounted to five hundred. Mr. Miller expressed his opinion, that before the season had too far advanced one other division might have been effected, when the number might have been at least quadrupled. The five hundred plants proved extremely vigorous, much more so than wheat under ordinary culture, so that the number of ears submitted to the sickle was 21,109, or more than forty to each of the divided plants: in some instances there were one hundred ears upon one plant. The ears were remarkably fine, some being six or seven inches long, and containing from sixty to seventy grains. The wheat, when separated from the straw, weighed forty-seven pounds and seven ounces, and measured three pecks and three quarters, the estimated number of grains being 576,840.

Such an enormous increase is not of course attainable on any great scale, or by the common modes of culture; but the experiment is of use as showing the vast power of increase with which the most valuable of vegetables is endowed, and which, by judiciously varying the mode of tillage, may possibly in time be brought into beneficial action.

The ordinary produce of wheat varies exceedingly, depending much upon the quality of the soil, the nature of the season, and the mode of culture. The average produce of the soil of a country depends, as does every other species of production, upon the advance of its inhabitants in knowledge and in the possession of capital.

It has been conjectured, that in the thirteenth century an acre of good land in England would produce twelve bushels of wheat.* In two centuries this rate of produce appears to have greatly increased. Harrison, writing in 1574, says, "The yield of our corne-ground is much after this rate following:—Throughout the land (if you please to make an estimate thereof by the acre), in meane and indifferent years, wherein each acre of rie or wheat, well tilled and dressed, will yield commonlie sixteene or twentie bushels; an acre of barley, six-and-thirtie bushels; of otes, and such like, four or five quarters; which proportion is notwithstanding oft abated toward the north, as it is oftentimes surmounted in the south."† The mean produce in Great Britain, according to the estimate of Mr. Arthur Young, did not, at the time when he wrote (about fifty years ago), exceed twenty-two and a half bushels per acre. Other and later writers have calculated the average at from twenty-four to twenty-eight bushels; while the author of the Reports on Agriculture for Middlesex has asserted, that the medium quantity in that county is forty bushels the highest produce he has known being sixty-eight and the lowest twelve bushels per acre. The land in the county which was the subject of these Reports, owing to its proximity to the metropolis, may be considered as in a state of high condition, and much beyond the ordinary rate of fertility. At all times, and in every country, some situations will be found more prolific than others, and some individuals will be more successful in their agricultural labours. Pliny has related a case which occurred among the Romans, where this success was seen in so marked a degree that the able agriculturist who, by excelling his countryman, had rendered himself the object of envy, was cited before the Curule Edile and an assembly of the people to answer to a charge of sorcery, founded on his reaping much larger crops from his very small spot of ground than his neighbours did from their

* Sir J. Cullum's 'History of Hawkstead,' quoted in Eden's 'History of the Poor,' vol. i. p. 18.

† 'Description of Britain' prefixed to Holingshed.

extensive fields. "In answer to this charge Cæsinus produced his efficient implements of husbandry, his well-fed oxen, and a hale young woman his daughter, and pointing to them, exclaimed,—'These, Romans, are my instruments of witchcraft; but I cannot here show you my labours, sweats, and anxious cares.'"*

It will easily be conceived that the quantity of straw must vary considerably from year to year, according to the seasons, and that this produce will likewise be generally influenced by the nature of the soil. It is, therefore, impossible to give any certain information upon this point; but it will perhaps amount to a near approximation to the truth if we consider that for every twelve bushels of wheat one load, containing thirty-six trusses of straw, will be obtained, the weight of which is 11 cwt. 2 qrs. 8 lbs. The straw of summer wheat is more agreeable to cattle than that produced from winter sowing.

This most important vegetable is not wholly free from casualties apart from climate. The principal of these are blight, mildew, and smut. The examination and treatment of these diseases have proved fruitful topics with writers on agricultural subjects. It does not, however, appear that the public has hitherto benefited much by their speculations, and an author of considerable eminence is so far of a contrary opinion as to have asserted, that "in proportion as words have been multiplied upon the subject, the difficulties attending its elucidation have increased."†

Blight is a disorder to which the cereal grains are known to have been liable from the earliest times. Among the ancient Greeks it was regarded as a sign of wrath on the part of their offended deities; and whenever it occurred they consequently gave themselves up to the infliction, without any thought of providing a remedy. The same superstitious notion was entertained by the Romans, who believed that the evil, which they

* 'Nat. Hist.,' book xviii. chap. 6.

† Loudon's 'Encyclopædia of Gardening,' p. 233.

called *rubigo*, was under the control of a particular deity named Rubigus, to propitiate whom in favour of their crops sacrifices were continually offered.

Blight and mildew have been very much confounded together by different writers on agricultural subjects, so as to render it doubtful to which class of appearances each name should, in strictness be applied, or whether, indeed both are not applicable to one and the same disorder occurring at different periods of the growth of the plant. Wishing to avoid entering upon debateable ground in noticing a subject which remains intricate and obscure, notwithstanding all the laborious treatises to which it has given rise, the forms which the disorders assume, and the bad effects by which they are followed will be plainly but briefly described, leaving the question of their classification to more professional hands.

Three distinct and dissimilar causes are assigned for the production of these disorders—cold and frosty winds, sultry and pestilential vapours, and the propagation of a parasitical fungus. The first of these causes acts by stopping the current of the juices; the leaves, being then deprived of a necessary portion of nutriment, speedily wither and die, when the juices, which are impeded in their passage, swell and burst the vessels, becoming then the food of myriads of little insects. These make their appearance so suddenly as to have been considered the cause rather than one of the effects of the disease. The second cause of blight occurs after the grain has attained its full growth. It has been observed, to happen mostly after heavy showers of rain, which, occurring about noontide, have been succeeded by clear sunshine. The plants are most commonly attacked thus about the middle or end of July. Mr. Loudon informs us that "in the summer of 1809 a field of wheat, on rather a light and sandy soil, came up with every appearance of health, and also into ear, with a fair prospect of ripening well. About the beginning of July it was considered as exceeding anything expected from such a soil. A week afterwards a portion of the crop on the east side of the field, to the extent of several acres, was totally destroyed, being

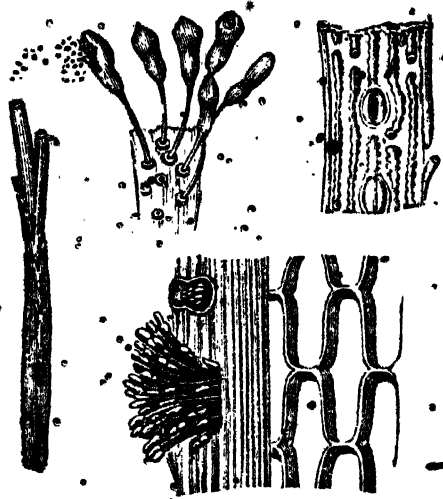
shrunk and shrivelled up to less than one-half the size of what it had formerly been, and so withered and blasted as not to appear to belong to the same field. The rest of the field produced a fair crop."* This disorder attacks either the leaves or stem of the plant, which appear to be covered by broken lines of a black or deep brown colour. This disease has been ascertained to result from the presence of a very minute species of fungus, the roots of which are inserted into the stem, and absorb the nourishment intended for the grain, which, when the plant is thus attacked, proves little else than husk. The minute seeds of the parasitical plant which occasion this mischief are so exceedingly light that they are borne along by the air to considerable distances. They are likewise of extraordinary quick growth, occupying in warm weather, according to the opinion of Sir Joseph Banks, not longer than one week from the time of their insertion in the plant to the production of their seed. Every pore in the straw whereon they fix will present from twenty to forty plants, so that the extent to which this mischief spreads is difficult to be imagined. Fungus thrives best in damp and shady situations, a circumstance which seems to point out naturally the propriety of providing means for the free ventilation of the fields, keeping low the hedges and fences by which they are surrounded. For the same reason it is found that thin crops, and such as are sown by drilling or dibbling, are the most likely to escape.

It has been often asserted, and was for a long time believed, that the neighbourhood of barberry bushes was hurtful by attracting the noxious fungus, but this idea is now classed among unfounded prejudices.

The grain of mildewed plants is found to be perfectly good for seed, and being smaller than sound grain, a less measure is required for the purpose.

Another formidable disease to which corn is liable is known under the characteristic name of smut. This injury consists in the conversion of the farina of the

* 'Encyclop. of Gard.,' p. 237.



Corn Mildew—*Uredo frumenti*—greatly magnified.

grain into a sooty powder, which is more or less black and offensive to the smell. Some authors have divided this evil under two different names, retaining that of *smut* for one of its modifications, while that of *burnt-grain* has been given to the other. Mills, in his 'System of Practical Husbandry,' has drawn the line of distinction between the two in the following terms:—"Smut, properly so called, occasions a total loss of the infected ears; but as the black powder which it produces is very fine, and the grains of that powder do not adhere together, wind and rain carry them away, so that the husbandman houses little more than the straw, which does not infect the sound grains, and scarcely damages their flour. The *burnt* or *carious* grains are, on the contrary, often housed with the sound grains, which they

infect with a contagious distemper, at the same time that they render its flour brown and give it a bad smell." The name under which this disease was known by the Romans was *ustilago*; by the French farmers it is called *charbon*.

If a portion of the black powder be first wetted with water, and then put under the microscope, it will be found to consist of myriads of minute globules, transparent, and apparently encompassed by a thin membrane. The cause of this disease has been held by some investigators to originate in the soil wherein the grain is sown; others have attributed it to the growth of a fungus within the ear; while others again have affirmed that it is owing to a diseased state of the seed whence the plant is produced. The result of various experiments conducted with different seeds sown in the same spot, and subjected to the same culture, appears to confirm the correctness of the last hypothesis.

The average weight of a bushel of wheat is about sixty pounds. Inferior samples seldom weigh less than fifty-six pounds, and the best as seldom exceed sixty-two pounds.

A bushel of wheat of the average weight will yield, on being ground,

Of bread flour	47	pounds.
fine pollard	4½	
coarse pollard	4	
bran	2½	
	11	„
Loss of weight in the processes of grinding and dressing	2	„
	60	„

In estimating the value of the flour of wheat as an article of diet, regard must be had to its composition. It will be seen from the table before given that the proportion of the nitrogenous or azotised secretions to the carbonaceous or non-azotised, is as one to four; and Liebig calculates that this is about the proportion which these secretions should bear to each other, however

varied the diet, for people who live in temperate climates. It is undoubtedly this composition which has given to wheat its great importance as the staple article of diet in Europe, and has led to its increased consumption in this quarter of the globe. Flour is made into bread and a number of other forms of food which we need not mention here. There are one or two points, however, in the use of flour as diet to which we may call attention. It is very common to mix the flour of wheat with lard, butter, and other fatty matters for making pie-crust, pudding, cake, &c. In this form it is not so digestible as when the oleaginous matter is added to it after cooking. It appears that when exposed to heat the starch of the flour combines with oil, and forms a compound which is less easily digested than either of them separate. Although where the digestion is good and the health robust, this is a matter of little importance, yet with the valetudinarian and the dyspeptic it should always be regarded, and many would retain the integrity of their digestive powers by refraining from such food, who now forfeit it by indulgence.

Another point of importance in the preparation of flour as food, is the mode of making bread. It is ordinarily made by the addition of yeast to flour and water made into a dough; the yeast converts the starch or sugar into alcohol by the process of vinous fermentation, and the consequence is that carbonic acid is given off; the dough being exposed to the heat of the oven during this process the carbonic acid escapes, forming bubbles in its course, which renders the bread lighter than it otherwise would be. But during this process a loss of the material of the bread takes place, and it has lately been proposed to mix with the dough carbonate of soda and hydrochloric acid. Carbonic acid is thus disengaged, and chloride of sodium, common salt is formed, and the former acts on the dough in the same manner as in the first process, and no loss of substance takes place.

CHAPTER IV.

RYE—BARLEY—OATS.

Ear and Plant of Rye.

Rye (*Secale cereale*). In former times this grain was much more extensively cultivated among us than it has been of late years. Not two centuries have passed since rye flour, either by itself or mixed with wheat, furnished nearly all the bread consumed by the labouring classes in England.

At present rye is cultivated by our farmers principally

that they may draw from it a supply of green food for their flocks. For this purpose the plants, which are sown in November, are eaten early in the spring, before they begin to spindle, which they will do towards the end of March. After this stage of the growth has taken place the succulent quality of the blade is impaired; it becomes coarse and harsh, and is no longer agreeable to animals. When rye is left to ripen its seeds, these are, for the most part, applied in this country to purposes distinct from human food; the principal use to which the grain is put being the preparation of a vegetable acid, to be employed by tanners in an operation which they call *raising*, and whereby the pores of the hides are distended, so as to dispose them the more readily to imbibe the tanning principle of the oak-bark, which is afterwards applied. Rye, when parched and ground, has been recently used as a substitute for coffee. It would be difficult, however, to convince any one accustomed to the use of this grateful beverage, that the grain of home production is ever likely to take place, at least to any extent, of the fragrant Mocha bean.

Rye straw is useless as fodder, but forms an excellent material for thatching, and is so suitable for stuffing horse-collars, that saddlers will usually pay for it a very good price.

Botanists distinguish four species of this plant—

Secale villosum,
Secale orientale,
Secale creticum, and
Secale cereale;

the last only of which is cultivated in Britain. This, which is said to be a native of Candia, was introduced into England many ages ago. There are two varieties of this species, occasioned more probably by difference of culture than by any inherent variance in the plants: one is known as winter and the other as spring rye.

It was formerly usual to sow rye together with an early kind of wheat. The harvested grain, thus necessarily intermixed, was termed *meslin*, from *miscellanea:*

it also obtained the name of *mung-corn*, corruptly from *monk-corn*, because bread made with it was commonly eaten in monasteries.

With the exception of wheat, rye contains a greater proportion of gluten than any other of the cereal grains, to which fact is owing its capability of being converted into a spongy bread. It contains, likewise, nearly five parts in every hundred of ready-formed saccharine matter, and is in consequence easily convertible into malt; and thence into beer or ardent spirit; but the produce of this last is so small, in comparison with that of malted barley, as to offer no inducement for its employment to that purpose. Rye has a strong tendency to pass rapidly from the vinous to the acetous state of fermentation, and whenever that circumstance has intervened, it would be vain to attempt either to brew or to distil it. Unmalted rye meal is mixed in Holland with barley malt, in the proportion of two parts by weight of the former, with one part of the latter, and the whole being fermented together forms the wash whence is distilled all the grain spirit produced in that country, and known throughout Europe as Hollands Geneva. There must, however, be some circumstances of a peculiar nature connected with the process, as conducted by the Dutch distillers, since no attempts made elsewhere have ever been successful in obtaining a spirit having the same good qualities.

Rye is the common bread-corn in all the sandy districts to the south of the Baltic Sea and the Gulf of Finland, furnishing abundance of food for the numerous inhabitants of places which, without it, must have been little better than sandy and uninhabitable deserts. In these districts it not only forms the chief article of consumption, but furnishes a material of some consequence to the export trade of the Prussian ports.

The peasantry in Sweden subsist very generally upon rye-cakes, which they bake only twice in the course of the year, and which, during most part of the time, are consequently as hard as a board.—Linnæus observed a curious practice in Lapland. One part of rye and two

parts of barley being mixed together, the seed is committed to the ground as soon as the earth is capable of tillage in the spring. The barley shoots up vigorously, ripens its ears and is reaped; while the rye merely goes into leaf without shooting up any stem, its growth being retarded by the barley, which may be said to smother it. After the barley is reaped, the rye advances in growth, and, without any further care of the cultivator, yields an abundant crop in the following year.

This grain, to which so many human beings are thus indebted for aliment, is subject to a disease which, when it occurs, not only deprives it of all its useful properties as food, but renders it absolutely noxious, and it may even be said poisonous, to man. When thus diseased it is called by English farmers *horned rye*, and by the French *ergot*, from the fancied resemblance to a cock's spur of an excrescence which the grain then bears. The bodies to which this name is given are solid elongated masses growing from the inside of the ovary of rye and other grasses, rootless, of a firm mealy substance, with a concrete scaly or powdery crust. Fries says they have no proper fructification, but other authors state that the interior is composed of flocci and sporules firmly compacted into a solid homogeneous mass. The precise nature of these grains, both on account of their peculiar medicinal effects and their poisonous quality when taken as food, has excited much attention amongst botanical observers. Willdenow supposed the ergot to be merely a diseased state of the grain, and stated that he could produce it at pleasure by excessive watering. General Field made some observations which led him to suppose that it originated from the puncture of insects. De Candolle and others more recently determined that the ergot was a distinct parasitic plant, developing itself from the ovary of grasses, and referred it to the genus *Sclerotium*. Fries, in his 'Systema Mucologicum,' considered the ergot to be a diseased state of the grain, and placed it in the doubtful genus *Spermœdia*. More recently this production has been carefully investigated by Mr. Edwin Quekett, who communicated the results of his

observations to the Linnæan Society, in November, 1838. From his investigations it appears that the great mass of the ergot consists of the albuminous matter of the grain in a diseased state. The interior of these grains had been described as being filled with flocci and sporules compacted together; but on examination with the microscope, after the outside was scraped off the interior was found to be composed of irregular cells filled with globules of a fatty oil. The cause of this changed state of the internal parts of the grain was found on the outside of the ergotized grain, where a number of very small oval or elliptical bodies were found about one six-thousandth of an inch in diameter, and containing within them a number of smaller granules. These were found to be the sporidia and sporules of a fungoid plant which, attached to the filaments, developed themselves early in the growth of the grain and produced its diseased state. Mr. Quekett has since succeeded in obtaining ergotized rye by applying to healthy plants of rye water containing the sporule of this fungus diffused through it, thus affording additional proof that plants become diseased by imbibing the seeds or sporules of other plants from the soil in which they grow.

At the meeting of the British Association for the Advancement of Science, at Cambridge, in 1845, Dr. Robert Latham read a paper on Ergot, in which he drew attention to the fact that the attacks of this disease, on other grasses besides rye, were very frequent, and pointed out the danger of allowing animals to feed on grass so diseased. It has been stated that this disease of the grain usually appears when a wet spring is succeeded by an unusually hot summer.

Tissot, a French physician, has paid much attention to the consequences on the human system of eating the spurred rye. Bread which is made of rye thus diseased has an acrid and nauseous taste, and its use is followed by spasmodic symptoms and gangrenous disorders. These effects cannot by any means be classed among imaginary evils. In 1596 an epidemic prevailed in Hesse, which was wholly ascribed to the use of

horned rye. Some of the persons who had unfortunately partaken of this food were seized with epilepsy, the attacks of which, for the most part, ended fatally; of others, who became insane, few ever fully recovered the proper use of their senses; while some, who were apparently restored, were liable through life to periodical returns of their disorder.

Similar calamities were experienced in different parts of the Continent at various times, between 1648 and 1736, and these visitations have been recorded by Burghart, Hoffman, and others. In 1709, this diseased condition of the rye occurred in a part of France to such a degree, that in consequence of it no fewer than five hundred patients were at one time under care of the surgeons at the public hospital at Orleans. The symptoms first came on with all the apparent characteristics of drunkenness, after which the toes became diseased, mortified, and fell off. The disorder thence extended itself up the leg, and frequently attacked the trunk, and this sometimes occurred even after amputation of the diseased limbs had been performed, with the vain hope of stopping the progress of the disorder.

The poisonous quality of horned rye is not exerted upon human beings alone, both insects and larger animals having been fatally affected by it; even flies, that merely settled casually upon the grain, have been killed by that means; and deer, swine, and different kinds of poultry, upon which experiments were tried, all died miserable deaths; some in strong convulsions, and others with mortified ulcers. These circumstances must have been truly appalling by their severity and the frequency of their recurrence. Few evils, however, are wholly of an unmixed character, and this one is not of the number. *Ergot of rye*, which was formerly productive of so much misery, has since found admission as a medicine into our pharmacopœias, and is now, in the hands of skilful and honest practitioners, rendered subservient to the interests of society. Horned rye is of very rare occurrence in Great Britain.

Ear and Plant of Common Spring Barley.

BARLEY (*Hordeum*) is, next to wheat, the most important of all the cereal grains which are now cultivated in Great Britain. Its use as bread-corn has very much diminished of late years in this country, while its employment for the production of stimulant liquids has, on the contrary, materially increased.

The Egyptians have a tradition, from which they believe that of all the grains barley is that one which was first used for the sustenance of man. Their histories assert that a knowledge of the art of cultivating this grain was imparted to their ancestors by the goddess Isis, who, having discovered the plant growing wild in the woods, instructed men how to cultivate it, so as at once to increase the quantity and improve the quality of its produce.

Uninstructed people are generally prone to refer to supernatural agency, the origin of all events for which they are otherwise unable to account. Dr. Franklin has related, as coming from the lips of a chief of the Susquehannah Indians, a tradition very similar to that of the Egyptians. "In the beginning," said this child of nature, "our fathers had only the flesh of animals to subsist on; and if their hunting was unsuccessful they were starving. Two of our young hunters having killed a deer, made a fire in the woods to broil some part of it. When they were about to satisfy their hunger, they beheld a beautiful young woman descend from the clouds, and seat herself on that hill which you see yonder among the blue mountains. They said to each other, It is a spirit that perhaps has smelt our broiling venison, and wishes to eat of it; let us offer some to her. They presented her with the tongue; she was pleased with the taste of it, and said, Your kindness shall be rewarded. Come to this place after thirteen moons, and you shall find something that will be of great benefit in nourishing you and your children to the latest generations. They did so, and to their great surprise found plants they had never seen before, but which from that ancient time have been constantly cultivated among us to our great advantage. Where her right-hand had touched the ground, they found maize; where her left-hand had touched it, they found kidney-beans; and where she had seated herself they found tobacco."

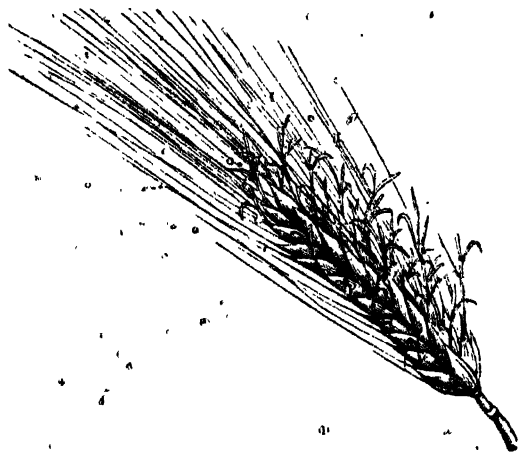
The native country of barley is as little known as that of wheat. Some travellers have mentioned it as being produced in a wild state in distant parts of the world; but there is reason for believing that all statements to this effect have been founded in error, since the hardiest varieties of the cultivated grain have never yet been seen to propagate themselves during two following years. The seed of cultivated barley, when chance-sown, will indeed produce plants; but the grains which these bear are rarely, if ever, seen to germinate. Some grasses which have been placed by

botanists in the same genus with barley, bear to it a strong outward resemblance, yet none of them can, by any degree of culture, be brought into use as human food, nor indeed be made to exhibit any marked improvement. One of these grasses, the *Hordeum murinum* of Linnæus, known commonly as wall-barley, bears the nearest resemblance of any to the cultivated plant.

In one respect barley is of more importance to mankind than wheat. It may be propagated over a wider range of climate, bearing heat and drought better, growing upon lighter soils, and coming so quickly to maturity, that the short northern summers which do not admit of the ripening of wheat, are yet of long enough duration for the perfection of barley. It is the latest sown, and the earliest reaped of all the summer grains. In warm countries, such as Spain, the farmers can gather two harvests of barley within the year, one in the spring from winter-sown grain, and the other in autumn from that sown in summer. Barley sown in June is commonly ready for the sickle in three months from the time of the seed being committed to the ground; and in very northern climates the period necessary for its growth and perfection is said to be of still shorter duration. Linnæus relates, in his tour in Lulean Lapland, that on the 28th of July he observed the commencement of the barley harvest, and although the seed was sown only a few days before Midsummer, that the grain was perfectly ripe, the whole process having thus occupied certainly not longer than six weeks.

The property of not requiring moisture admirably fits barley for propagation in those northern countries where the duration of summer is limited to a very few months in the year, and where wet is of very rare occurrence from the time when the spring rains are over, at the end of May or the beginning of June—after which period the seed-time commences—until the autumnal equinox, previous to which the harvest is reaped.

So hurtful is excessive moisture to the plants, that even heavy dews, if of frequent occurrence, are found injurious. Wet is detrimental at all periods; but the



Premature germination of an ear of Barley.

mischief is exhibited in a very different manner, according as it occurs before or after the formation of the ear. If during the former stage, the leaves, as already mentioned, will become yellow and sickly, and the ears will probably not make their appearance; whereas if these should already have been formed and completely filled when visited by rain, the grain will sprout in the ear, and should the weather which follows be warm and genial, this growth will be so rapid that the ears will put on the appearance of tufts of grass. Barley is besides very liable to be beaten down by rain and to lodge; and should this occur after the filling of the ear, germination of the grains will take place to such a degree that the first growth will be completely rotted and destroyed by the second. Gentle showers, however, if of short continuance, and if they do not happen either very early after the plant is above the ground, or during the time of blooming, or when the ear is full,

are rather beneficial than hurtful. It is worthy of remark that the very quality which renders barley so precarious a crop in unsettled climates, imparts to it likewise its chief value. The facility with which the grain is made to germinate is favourable to the operation of converting it into malt, which is, in fact, simply the process of germination induced and carried forward up to and not beyond the point when the maximum quantity of saccharine matter is developed in the grain.

In its composition barley differs from wheat: it contains more starch, less gluten, and a small quantity of saccharine matter ready formed, which latter constituent wheat does not possess previous to germination.

Botanical writers enumerate four distinct species of barley: of these there are many varieties produced by differences of soil, climate, and culture.

SPRING BARLEY (*Hordeum vulgare*) is the kind most commonly cultivated in England. Of this species farmers distinguish two sorts; one the common, and the other the *rath-pipe* barley. These, in fact, are the same plant, the latter being a variety occasioned by long culture upon warm gravelly soils. If seeds of this kind are sown in cold or strong land, the plants will ripen nearly a fortnight earlier than seeds taken from other strong land; but this holds good only during the first year. This variety is said in extraordinary seasons to have been returned to the barn within two months in this country. Siberian barley, another variety, was brought into culture in the year 1768, by Mr. Halliday, who received a very small portion out of about a pint of seed which had been presented by a foreign nobleman to the London Society for the Encouragement of Arts. This variety exhibits, on first coming up, a broader blade, and is of a deeper green than common barley. The ears are shorter, containing only from five to nine grains in length, while the common sort has from nine to thirteen grains. Siberian barley arrives at maturity about a fortnight earlier than other kinds.

WINTER or SQUARE BARLEY, called also BEAR, or BIG (*Hordeum hexastichon*) is the second species (β).

Ear and Plant of Winter Barley.

This is rarely cultivated in the southern parts of England; but in the northern counties and in Scotland is very generally sown, being a much more hardy plant than spring barley. The grains are large and plump, and the spike is thicker and shorter than the last described species, being seldom longer than two inches, and square. Maltsters in the southern division of the kingdom are of opinion that this barley does not answer their purpose so well as that more usually cultivated among them, while in Scotland this idea is considered to be an unfounded prejudice.

The number of grains in each ear is greater than are found on spring barley in the proportion of three to two, one ear frequently yielding forty or more grains. These are disposed in six rows, two of these being on each of two sides, and one row on each of the other sides.

Ear and Plant of Two-rowed Barley.

Long-eared Barley, sometimes called Two-rowed Barley (*Hordeum distichon*) is partially cultivated in every part of England, and is a very good sort. Some persons object to it, that the ears being long and heavy, it is more apt to lodge than other kinds. The grains are regularly disposed in a double row, lying over each other like tiles on a roof, or like the scales of fishes. The ear is somewhat flatted, being transversely greater in breadth than in thickness. The husk of the grain is thin, and its malting qualities are excellent.

Sprat or Battledore Barley (*Hordeum zeocriton*) has shorter and broader ears than either of the sorts already described; its awns or beards are longer, so that birds cannot so easily get out the grains, which also lie closer together than those of other kinds. Sprat barley seldom, if ever, grows so tall as either of the

other species, and its straw is not only shorter, but coarser, so as to render it not desirable for use as fodder.

It was formerly the universal practice in this country to sow barley in the spring. The end of March or beginning of April was the more usual time, but the sowing was sometimes deferred to the beginning of May. The practice in this respect has somewhat varied of late, and a more early season has been chosen for sowing, so that it is not uncommon for the process to be performed in January, under the idea that the produce in such cases is greater. In the county of Norfolk, where the cultivation of barley is carried forward very extensively, and with the greatest skill, the farmers were formerly guided in their choice of seed time by a maxim which had long been handed down to them from father to son:—

"When the oak puts on his gosling grey,
'Tis time to sow barley night and day;"

meaning, that when the oak exhibits the grey appearance which accompanies the bursting of its buds, a few days preceding the expansion of the leaves, it is then improper to lose any time in getting their seed-barley into the ground. The budding and leafing of the birch tree is, in Sweden, considered an indication of the proper time for barley-sowing. In different countries there are, of course, different natural guides in the operations of husbandry; but an intelligent and observing farmer, in every country, will not fail to regard those which have been sanctioned by experience; while the agriculturist, who is bound by a servile adherence to particular months, and even weeks for his operations, will unwisely treat as old saws such relics of the practical skill of our forefathers as the lines we have quoted. Linnæus, the great Swedish naturalist, constantly exhorted his countrymen to observe at what time each tree unfolds its buds and expands its leaves. In our own country, Mr. Stillingfleet, an eminent naturalist, made a series of very accurate observations upon this interesting

appearance of the spring. A farmer who would keep a calendar of Nature in the same manner for a few years, and at the same time register his days of sowing and the issue of his harvest, would secure, no doubt, a valuable collection of rules for his guidance, peculiarly applicable to the exact circumstances of situation and soil amidst which he pursues his calling.*

The produce of barley, according to the quality of the soil, is from three to four quarters to the acre. A larger produce is not unfrequent; and even so much as seven quarters have been reaped in very favourable seasons and situations.

The average weight of a Winchester bushel of barley is between fifty and fifty-one pounds, and the same measure of bigg weighs but little more than forty-six pounds. It is very seldom that the former is found to weigh beyond fifty-two, or the latter beyond forty-eight pounds to the bushel. The average length of a grain of barley, taking the mean of many thousand measurements, is 0·345 inch, while that of a grain of bigg is 0·3245 inch. The medium length of these two species gives, therefore, as nearly as possible, one third of an inch, which agrees with the lowest denomination or basis—the barleycorn of our linear measure.†

The purposes to which barley is principally applied in this kingdom are those of brewing and distilling. Some portion is still brought more directly into consumption as human food; but this portion, for the most part, now undergoes the previous process of decortication (removal of the bark), whereby it is converted into what is called Scotch or pearl barley. This grain, in its raw state, is also used to some extent for feeding poultry and fattening swine, for which latter purpose it is commonly converted into meal. The ancients were accustomed to feed their horses upon barley, as is the case among the Spaniards to the present day; and Pliny relates (book xviii. c. 7) that the Roman gladiators were called '*Hordearii*, from their use of this grain as food.

* See Howitt's 'Book of the Seasons,' p. 99.

† 'Supp. Encyc. Brit.,' *art.* 'Brewing.'

The use of barley in the preparation of a fermented liquor dates from the very remotest times. The invention of this preparation is ascribed to the Egyptians by antient Greek writers, one of whom, Dioscorides, attributes the first cultivation of barley to the same people, under the guidance of Osiris; while Herodotus informs us that the people of Egypt, being without vines, made their wine from barley.* Pliny, in his 'Natural History,' gives the Egyptian name of this liquid as Zythum.† An intoxicating liquor is still made from this grain, both in Egypt and Nubia, to which the name of *bouzah* is given. This is of very general consumption among the lower rank of people. Burckhardt observed another use to which barley is applied in the latter country. The green ears are boiled in water, and served up to be eaten with milk. Among the Greeks beer was distinguished as *barley wine*, a name which sufficiently identifies the intoxicating property of the liquid, and the material whence this was drawn. From a passage in Tacitus we learn that the German people were in his day acquainted with the process of preparing beer from malted grain; and Pliny describes a similar liquid under the name of Cerevisia, an appellation which it retained in Latin books of more recent date. It further appears that malt liquor has formed an article of manufacture and consumption in this country for a period at least coeval with the time of Tacitus; but we do not know whether any one kind of grain was exclusively employed in its preparation, or whether wheat and barley were not used for the purpose, either indiscriminately or in conjunction.

The general drinks of the Anglo-Saxons were ale and mead: wine was a luxury for the great. In the Saxon Dialogues preserved in the Cotton Library in the British Museum, a boy, who is questioned upon his habits and the uses of things, says, in answer to the inquiry what he drank—"Ale if I have it, or water if I have it not." He adds, that wine is the drink "of the elders and the wise." Ale was sold to the people, as at this day, in houses of entertainment; "for a priest was forbidden by

* Lib. ii. cap. 78. † Nat. Hist. lib. xxii. c. 25.

a law to eat or drink at *ceapealethetum*, literally, places where ale was sold."* After the Norman conquest wine became more commonly used; and the vine was extensively cultivated in England. The people, however, hold to the beverage of their forefathers with great pertinacity; and neither the juice of the grape nor of the apple were ever general favourites. The wassail song of the fifteenth century, whose burden was—

"Bring us home good ale,"

was indicative of their attachment to this beverage. "The old ale knights of England," as Camden calls the sturdy yeomen of this period, knew not, however, the ale to which Hops in the next century gave both flavour and preservation. Hops appear to have been used in the breweries of the Netherlands in the beginning of the fourteenth century. In England they were not used in the composition of beer till nearly two centuries afterwards. It has been affirmed that the planting of hops was forbidden in the reign of Henry VI.; and it is certain that Henry VIII. forbade brewers to put hops and sulphur into ale.† In the fifth year of Edward VI. the royal and national taste appears to have changed, for privileges were then granted to hop-grounds. Tusser, in his five hundred points of good husbandry, printed in 1557, thus sings the praises of this plant:—

"The hop for his profit I thus do exalt,
It strengtheneth drink and it flavoureth malt;
And being well-brewed long kept it will last,
And drawing abide, if ye draw not too fast."

In the reign of James I. the plant was not sufficiently cultivated in England for the consumption, as there is a statute of 1608 against the importation of spoilt hops. In 1830 there were 46,727 acres occupied in the cultivation of hops in Great Britain.

Of barley there are above thirty million bushels an-

* Turner's 'Anglo Saxons,' vol. iii. p. 32.
† 'Archæologia,' vol. iii.

nually converted into malt in Great Britain; and more than eight million barrels of beer, of which four-fifths are strong beer, are brewed yearly. This is a consumption, by the great body of the people, of a favourite beverage which indicates a distribution of the national wealth, satisfactory by comparison with the general poverty of less advanced periods of civilization in our own country, and with that of less industrious nations in our own day.

Common bearded Oats. Common Oats.

OATS (*Avena*). This grain is held to have had its origin in a more northern climate than any other of the cereal plants, since it cannot be cultivated with advantage in the lower latitudes of the temperate zone. In

the south of England, even at high elevations, the produce is inferior in quality to that which is obtained in more northern districts.

The time and mode of the introduction of oats into England are equally unknown, and some writers have expressed their opinion that this grain is indigenous with us. One thing appears sufficiently clear—the varieties cultivated here, at this time, have all been originally imported from different parts of the continent of Europe, the names of which countries they are made to bear.

This grain is extremely serviceable to man, possessing the advantage of growing upon soils and in situations where neither barley nor wheat can be raised. It is the hardiest of all the cereal grains that are cultivated in Great Britain. In its outward structure the oat-plant differs from wheat and barley in the form of the ear. This in oats is not a spike with a single rachis, but a panicle, resembling in some degree the stem and branches of a pine. While young and light, these branches arrange themselves round the centre of the stem; but as they advance towards maturity and acquire weight, they generally bend over on one side. By this arrangement the air and light are enabled to visit, and the rain to wash, each individual grain, so that any lodgment of the larvæ of insects or the seeds of parasitical plants is prevented. The grains being pendent, and having the open extremities of their chaff towards the earth, are effectually defended from the lodgment of rain within, an advantage which does not attend the growth of wheat or barley; and those grains are consequently liable to diseases from which oats are exempted. Drought and heat are unfavourable to this grain, which, under such circumstances, becomes husky and tasteless, containing but little farinaceous matter, and that little being of inferior quality.

The *Avena sativa*, which species is commonly cultivated, has several varieties. The most remarkable of these are the black or long-bearded oat; the white oat; red oat; and the naked oat, or pilcorn.

The best variety of oats produced in Great Britain is

unquestionably the *potato oat*. Of this kind the first plants were discovered growing accidentally on a heap of manure in company with several potato plants, the growth of which was equally accidental, and it is to this circumstance that the distinctive name of this variety is owing. To an occurrence thus purely accidental, and which might well have passed unnoticed, we are indebted for decidedly the best and most profitable variety we possess of this useful grain. It requires to be sown on land in a good state of cultivation, when the grains on ripening will be found large, plump, and firm, often double, and of a quality which ensures for the corn a higher price in the market than is given for any other variety. It also yields an abundant produce of straw. Potato oats form almost the only kind now cultivated in the north of England and the lowland districts of Scotland.

The seed-time of oats is almost universally in March and April. The grain is scattered broad-cast in the large proportion of from four to six bushels to the acre, the medium produce of which is from forty to fifty bushels.

The nutritive quality of oats is smaller in a given weight than that of other cereal grains. The very small proportion of saccharine matter ready-formed in oats renders it very difficult and unprofitable to convert this grain into malt. Brewers at the present day do not employ oats in the preparation of any kind of beer: in former times, when the public taste was different from what it is at present, a drink called *flum* was manufactured for sale, and in the preparation of this liquid oatmeal was employed. The principal use now made of oats in the southern division of the kingdom is the feeding of horses, for which purpose the grain is admirably adapted: a large quantity of this grain is further consumed in the fattening of poultry. The deer of Henry VIII. were fed with oats. In the Privy Purse Expenses of this king (published by Mr. Nicolas) is the following entry:—

"Paied to the keper of Grenewiche parke for xiij lode of hey And for vi lode of Oots, for the relief of the dere

there, And for the carriage thereof, vjli. ijs. viiid." Oatmeal, prepared by various processes of cooking, composes at this day a large proportion of the food of the inhabitants of Scotland, and particularly of the better-fed portion of the labouring classes. Oaten cakes, too, are much used in Lancashire.

The wild oat, which is certainly indigenous to this country, is found to be a very troublesome weed. It is said that the seed will remain buried under the soil during a century or more without losing its vegetating power, and that ground which has been broken up after remaining in grass from time immemorial has produced the wild oat abundantly.

It is a curious fact that the vital principle of some vegetables will lie dormant, under certain circumstances, for long and indefinite periods without being extinguished. Seeds have been made to grow in this country which were brought from Herculaneum, after having been buried for more than seventeen centuries, but which, having during all that period been deprived of air, had been prevented from vegetating. The necessity that exists for the access of air in some degree, in order to promote or set in action vegetable life, has been shown by the experiments of several ingenious men, who, having placed seeds under circumstances otherwise favourable to their growth, in the exhausted receiver of an air-pump, ascertained that they were thereby prevented from exhibiting any sign of vitality.

The following notes will give an idea of the cultivation of the Cerealia in this country in past times.

The Anglo-Saxon monks of the abbey of St. Edmund, in the eighth century, ate barley bread, because the income of the establishment would not admit of their feeding twice or thrice a day on wheaten bread.* The English labourers of the southern and midland counties, in the latter part of the eighteenth century, refused to

* Dugdale's 'Monasticon,' quoted in Turner's 'History of the Anglo-Saxons,' vol. iii. p. 25.

eat bread made of one-third wheat, one-third rye, and one-third barley, saying, that "they had lost their rye-teeth."* It would be a curious and not unprofitable inquiry to trace the progress of the national taste in this particular. It would show that whatever privations the English labourer may now endure, and whatever he has endured for many generations, he has succeeded in rendering the cleanest kind of vegetable food the general food of the country; this single circumstance is a security to him against those sufferings from actual famine which were familiar to his fore-elders, and which are still the objects of continual apprehension in those countries where the labourers live upon the cheapest substances. Wages cannot be depressed in such a manner as to deprive the labourer, for any length of time, of the power of maintaining himself upon the kind of food which habit has made necessary to him; and as the ordinary food of the English labourer is not the very cheapest that can be got, it is in his power to have recourse for a while to less expensive articles of subsistence should any temporary scarcity of food or want of employment deprive him of his usual fare—an advantage not possessed by his Irish fellow-subjects, to whom the failure of a rice or potato crop is a matter not of discomfort merely, but of absolute starvation. But the materials for such an inquiry are very imperfect; and although the assiduous devotion of an antiquary might collect many valuable illustrations from neglected records, it is evident that in the present instance we can do little more than put together a few scattered facts, which the diligence of previous inquirers has already collected.

In the Poem of Pierce Plowman, of the time of Edward III., it is said, that *when the new corn began to be sold*,

> "Woulde no beggar eat bread that in it beanes were,
> But of coket, and clemantyne, or else clene wheate."†

* 'Annals of Agriculture,' quoted in Eden's 'History of the Poor,' vol. i. p. 526.

† See the 'Athenæum,' a weekly literary paper, Feb. 3, 1832.

This taste, however, was only to be indulged "when the new corn began to be sold;" for then a short season of plenty succeeded to a long period of fasting; the supply of corn was not equalised throughout the year by the provident effects of commercial speculation. The fluctuations in the price of grain, experienced during this period, and which were partly owing to insufficient agricultural skill, were sudden and excessive. On the securing of an abundant harvest in 1317, wheat, the price of which had been so high as 80*s.*, fell immediately to 6*s.* 8*d.* per quarter.* The people of those days seem always to have looked for a great abatement in the price of grain on the successful gathering of every harvest; and the inordinate joy of our ancestors at their harvest-home—a joy which is faintly reflected in our own times—proceeded, there is little doubt, from the change which the gathering of the crops produced, from want to abundance, from famine to fulness. That useful class of men who employ themselves in purchasing from the producers that they may sell again to the consumers, was then unknown in England. Immediately after the harvest, the people bought their corn directly from the farmers at a cheap rate, and, as is usual under such circumstances, were improvident in the use of it, so that the supply fell short before the arrival of the following harvest, and prices advanced out of all proportion.

In a valuation of Colchester, in 1296, almost every family was provided with a small store of barley and oats, usually about a quarter or two of each. Scarcely any wheat is noticed in the inventory, and very little rye †. The corn was usually ground at home in a hand-mill or quern; although wind and water mills were not uncommon. The general use of the latter machines was probably prevented by the compulsory laws by which the tenant was under an obligation to grind his corn at the lord's mill; and, therefore, to evade the tax, called *multure*, the labour of the handmill was endured. In Wicliff's translation of the Bible we find a passage in

* Stow.

† For some particulars of another valuation of this town, see 'Capital and Labour,' p. 68.

the 24th chapter of St. Matthew thus rendered:—"Two wymmen schulen (shall) be gryndynge in one querne." Harrison, the historian, two centuries later, says, that his wife ground her malt at home upon her quern. In the present authorised version of the Bible, published more than half a century after Harrison, the word "quern" yields to "mill." By that time, probably, the trades of a miller and a baker were freely exercised; and the lord's mill and the corporation oven had been superseded by the competition growing out of increasing capital and population.

The Reformation, and the discovery of America, were events that had a considerable influence upon the condition of the great body of the people in England. The one drove away the inmates of the monasteries, from whence the poor were accustomed to receive donations of food: the other, by pouring the precious metals into Europe, raised the price of provisions. In the latter half of the sixteenth century, wheat was three times as dear, both in England and France, as in the former half. The price of wheat, upon an average of years, varied very little for four centuries before the metallic riches of the New World were brought into Europe; upon an average of years it has varied very little since.* The people of the days of Henry VIII. felt the change in the money-value of provisions although the real value remained the same; and they ascribed the circumstance to the dissolution of the monasteries. There is an old song of that day in the Somersetshire dialect, which indicates the nature of the popular error:—

"I'll teh thee what, good vellowe,
Before the clays went hence,
A bushel of the best wheate
Was zold for vourteen pence;
And vorty eggs a penny
That were both good and newe;
And this, I say, myself have seen,
And yet I am no Jewe."†

* See Storch, 'Cours d'Economie Politique,' tome i. p. 477.
† Relques of Ancient Poetry.

When wheat was fourteen-pence a bushel, it was probably consumed by the people, in seasons of plenty, and soon after harvest. During a portion of the year there is little doubt that the English labourers had better food than the French, who, in the fifteenth century, were described by Fortescue thus:—"Thay drynke water, thay eate apples, with bred right brown, made of rye." Locke, travelling in France, in 1678, says of the peasantry in his journal, "Their ordinary food, rye bread and water."* The English always disliked what they emphatically termed, "changing the white loaf for the brown." They would have paid little respect to the example of Masinissa, the African general, who is described by Polybius as eating brown bread with a relish at the door of his tent. Their dislike to brown bread in some degree prevented the change which they proverbially dreaded. In the latter part of the sixteenth century, however, this change was pretty general, whatever was the previous condition of the people. Harrison says, speaking of the agricultural population, "As for wheaten bread, they eat it when they can reach unto the price of it, contenting themselves, in the mean time, with bread made of oates or barlie, a poore estate, God wot!" In another place, he says, "The bread throughout the land is made of such graine as the soil yieldeth; nevertheless, the gentilitie commonlie provide themselves sufficiently of wheate for their own tables, whilst their household and poore neighbours, in some shires, are inforced to content themselves with rie or barlie." Harrison then goes on to describe the several sorts of bread made in England at his day, viz., manchet, cheat, or wheaten bread; another inferior sort of bread, called ravelled, and lastly, brown bread.† Of the latter there were two sorts. "One baked up as it cometh from the mill, so that neither the bran nor the floure are anie whit diminished. The other hath no floure left therein at all; and it is not only the worst and weakest of all the other sorts, but also appointed in *old time* for servants,

* Lord King's 'Life of Locke.'

† See Percy's Preface to the Northumberland Household Book,' Nicolas's edit. p. xiv.

slaves, and the inferior kind of people to feed upon. Hereunto, likewise, because it is drie and brickle in the working, some add a portion of rie-meale in *our time*, whereby the rough drinesse thereof is somewhat qualified, and then it is named mescelin, that is, bread made of mingled corne." In the household book of Sir Edward Coke, in 1596, we find constant entries of oatmeal for the use of the house, besides "otmell to make the poore folkes pofage," and "rie-meall, to make breade for the poore." The household wheaten bread was partly baked in the house and partly taken of the baker. In that year it appears, from the historian Stow, that there was a great fluctuation in the price of corn; and he particularly mentions the price of oatmeal, which would indicate that it was an article of general consumption, as well in a liquid form, as in that of the oat-cakes of the north of England.

In 1626, Charles I., upon an occasion of subjecting the brewers and maltsters to a royal licence, declared that the measure was "for the relief of the poorer sort of his people, whose usual bread was barley: and for the restraining of innkeepers and victuallers, who made their ale and beer too strong and heady." The grain to be saved by the weakness of the beer was for the benefit of the consumers of barley-bread.

At the period of the Revolution (1689) wheaten bread formed, in comparison with its present consumption, a small proportion of the food of the people of England. The following estimate of the then produce of the arable land in the kingdom tends to prove this position. This estimate was made by Gregory King, whose statistical calculations have generally been considered entitled to credit:—

	Bushels.
Wheat	14,000,000
Rye	10,000,000
Barley	27,000,000
Oats	16,000,000
Pease	7,000,000
Beans	4,000,000
Vetches	1,000,000
In all	79,000,000

At the commencement of the last century wheaten bread became much more generally used by the labouring classes, a proof that their condition was improved. In 1725, it was even used in poor-houses, in the southern counties.* The author of 'Three Tracts on the Corn Trade,' published at the beginning of the reign of George III., says, "It is certain that bread made of wheat is become much more generally the food of the common people since 1689 than it was before that time; but it is still very far from being the food of the people in general." He then enters into a very curious calculation, the results of which are as follow:—"The whole number of people is 6,000,000, and of those who eat

Wheat, the number is	3,750,000
Barley	739,000
Rye	888,000
Oats	623,000
Total	6,000,000

This calculation applies only to England and Wales Of the number consuming wheat, the proportion assigned to the northern counties of York, Westmoreland, Durham, Cumberland, and Northumberland, is only 30,000. Eden, in his 'History of the Poor,' says, "About fifty years ago (this was written in 1797), so small was the quantity of wheat used in the county of Cumberland, that it was only a rich family that used a peck of wheat in the course of the year, and that was used at Christmas. The usual treat for a stranger was a thick oat-cake (called haver-bannock) and butter. An old labourer of eighty-five remarks that when he was a boy he was at Carlisle market with his father, and wishing to indulge himself with a penny loaf made of wheat-flour, he searched for it for some time, but could not procure a piece of wheaten bread at any shop in the town."

* Eden, vol. i. p. 562.

CHAPTER V.

ON RICE.

The principal cereal plants which cannot be profitably cultivated in Great Britain, but upon which the inhabitants of other countries depend for subsistence in even a greater degree than the English peasantry depend upon the supply of wheat, are rice, maize, and millet. The seeds of these plants are less palatable than wheat, and less nutritious than that or any other of the cerealia already described: the chief cause of this last mentioned inferiority arises from the smaller quantity of gluten they contain.

The three grains just mentioned will be treated of in the order wherein they are here set down, which is likewise the order of their importance, considered with reference to the number of human beings who draw from them their sustenance.

Rice (*Oryza sativa*). This is a panicled grass, bearing, when in ear, a nearer resemblance to barley than to any other of the corn-plants grown in England. The seed grows on separate pedicles springing from the main stalk; each grain is terminated with an awn or beard, and is enclosed in a rough yellow husk, the whole forming a spiked panicle. The stalk is not unlike that of wheat, but the joints are more numerous. The flour of rice is almost entirely composed of starch, having little gluten, and being without any ready-formed saccharine matter. The outer husk clings with great tenacity to the grain, and is only to be detached from it by passing the rice between a pair of mill-stones, placed at such a distance from each other as shall serve to remove the husk by friction, without crushing the grain. This is besides,

enveloped by a thin pellicle, which for the most part is rubbed off by trituration in large mortars, with pestles weighing from two to three hundred pounds.

Ear and Plant of Rice (*Oryza sativa*).

There is little reason for doubting that this grain is of Asiatic origin. From the earliest records it has formed the principal, if not the only food of the great mass of the population on the continent and islands of India and throughout the Chinese empire.

The introduction of rice as an object of cultivation in America is of very modern occurrence. The author of a work 'On the Importance of the British Plantations in America,' which was published in London during the year 1701, has recorded, as a circumstance then recent, that "a brigantine from the island of Madagascar happened to put in at Carolina, having a little seed-rice left, which the captain gave to a gentleman of the name of

Woodward.' From part of this he had a very good crop, but was ignorant for some years how to clean it. It was soon dispersed over the province, and by frequent experiments and observations they found out ways of producing and manufacturing it to so great perfection that it is thought to exceed any other in value. The writer of this hath seen the said captain in Carolina, where he received a handsome gratuity from the gentlemen of that country, in acknowledgment of the service he had done the province. It is likewise reported that Mr. Dubois, then Treasurer of the East India Company, did send to that country a small bag of seed-rice some short time after, from whence it is reasonable enough to suppose might come those two sorts of that commodity; the one called red rice, in contradistinction to the white, from the redness of the inner husk or rind of this sort, although they both clean and become white alike."

There is a trifling discrepancy between the latter part of this account and the statement respecting Mr. Ashley, already mentioned in a former chapter; but the main fact, and the time of its occurrence, are the same; and it is probable that the latter gentleman may have acted in the matter under the instruction of Mr. Dubois.

The swamps of South Carolina, both those which are occasioned by the periodical visits of the tides, and those which are caused by the inland floodings of the rivers, are well suited for the production of rice; and not only is the cultivation accomplished with trifling labour, but the grain proves of a remarkably fine quality, being decidedly larger and handsomer than that of the countries whence the seed was originally derived.

It does not appear that this naturalizing of rice in Carolina and Georgia was ever productive of much effect in regard to the diet of the inhabitants of those provinces. Their consumption of rice was, doubtless, increased by it, because the abundance and cheapness of an article always influence persons to its use. But wheat and maize continued, as before, to be the bread-corn of the country, and the newly introduced grain was cultivated principally because it furnished an article in constant

demand which might be transmitted to the mother-country in return for British manufactured goods.

Had a contrary effect followed upon the introduction of rice into the then British colonies of America, and this grain had become, as in India, the universal food of the inhabitants, it is not probable that their condition would have been in any way ameliorated by the change. In countries where rice forms the chief article of food, dearths are not by any means of uncommon occurrence. A failure of the usual supply of rain, which is followed by evil consequences where other descriptions of grain are raised, is productive of tenfold misery where the chief dependance is upon the crop of rice, which, without its due degree of moisture, proves wholly unproductive. In such cases there can be found few sources of relief, other objects of cultivation being pursued to only a limited extent, and the means of the people not enabling them to compass the purchase of these scarcer articles of food, even when, through the general abundance, they may be procured at their natural price. Happily for the interests of humanity, dearths are becoming less and less frequent of occurrence, through the better understanding of subjects connected with the production and distribution of commodities. In England the people are especially guarded against this calamity by the diversity of the crops which are raised, and by the opportunity they thence enjoy of falling back upon articles of consumption less costly than those to which they are ordinarily accustomed. It is this circumstance which constitutes the advantage of the general use of wheaten bread — a taste which has been slowly but steadily acquired amongst us. In no way, perhaps, is the progress of a nation in civilization more unequivocally shown than in the improvement which it realizes in the food of the community. In the infancy of societies the people are necessarily satisfied with the enjoyment of such indigenous productions as fall most naturally within their reach. But in the more advanced stages of society, when articles of food, which at one time have been introduced as luxuries are so far naturalised as to form a part, at least, of the sustenance

of the common people, they, in the event of an unkindly season, have something upon which they can still fall back, so that what would otherwise be famine, is at worst changed into privation. "In those countries," it has been judiciously observed by the late David Ricardo, "where the labouring classes have the fewest wants, and are contented with the cheapest food, the people are exposed to the greatest vicissitudes and miseries. They have no place of refuge from calamity; they cannot seek refuge in a lower station; they are already so low that they can fall no lower. On any deficiency of the chief article of their subsistence, there are few substitutes of which they can avail themselves, and dearth to them is attended with almost all the evils of famine."

If a scarcity of food should be experienced in this country, the great bulk of the common people, nay even the very poorest amongst them, have, generally speaking, still some articles, that in foreign countries would be considered luxuries, which they can forego, some property which they can sacrifice, in order to satisfy the cravings of hunger. In India, on the contrary, and in most of the countries where rice forms the principal article of human food, the labouring classes are poor in the extremest sense of the word. Having few artificial wants, they are without those habitual incentives to exertion which actuate so powerfully and so beneficially people of the same rank in countries like our own. If they can acquire a meal for themselves and their families they have little thought about higher comforts; the price of labour in such countries is, in fact, equal to very little beyond the purchase of the lowest description of food: the Indian labourer is contented with the rudest hut as a place of shelter—he is without what we are accustomed to consider the most indispensable articles of household furniture, and his clothing consists of a few yards of the commonest cotton cloth. When the price of his ordinary food advances beyond the usual rate he is sunk into immediate wretchedness; he has no fund whereon he can draw for assistance, and the wages of his labour are so far from advancing under these circumstances that

the contrary tendency is uniformly experienced; and the competition for employment is increased while the means of paying for labour are diminished.

Some botanical writers enumerate four varieties of rice which they consider as being originally distinct from each other; while others have been of opinion that the unimportant varieties which these present, and which do not in any way affect the chemical or alimentary properties of the grain, are simply the effects of difference of soil, culture, and climate. The four varieties are—common rice, early rice, mountain rice, and clammy rice.

Common rice is a marsh plant. If the ground on which it is sown should become dry before the plants arrive at maturity, they wither. It is this variety which grows most strongly; and on lands peculiarly adapted for it the culture is probably as advantageous as can well be pursued.

Early rice, like the other, is a marsh plant, but it does not grow to the same size. It comes much sooner to maturity; for while common rice is never ripe in less than six months from the time of ploughing, this variety, if placed in favourable situations, requires only four months for arriving at perfection.

Mountain rice thrives on the slopes of hills and in other situations where it can receive humidity only occasionally. Dr. Wallich, the able successor of Dr. Roxburgh as superintendent of the botanical garden at Calcutta, sent to London a few years ago some specimens of rice grown on the cold mountains of Nepal. These seeds were furnished to him by the resident of the East India Company in that district, and were recognised by the Doctor as mountain rice. The degree of cold which this plant is qualified to bear is very great. According to the information collected on the subject by Dr. Wallich, the cultivators consider their crops quite safe if the growth of the plants is advanced five or six inches above the surface at the time the winter snows cover the ground. It is probable that the slow melting of the snow is beneficial to the growth of the plant, which advances with great vigour on the return of spring.

A knowledge of these circumstances might have led to the opinion that this variety of rice could be naturalized in England, if the attempt had not already been fairly made by one well qualified for conducting the experiment. Samples of six different sorts of mountain rice which had been procured by Sir John Murray from the neighbourhood of Serinagur at the foot of Mount Imaus, were, on the occasion alluded to, presented by the Board of Agriculture to Sir Joseph Banks, who planted each kind in a separate bed, in a sheltered spot with a south aspect, in his garden at Spring Grove. The grains, which were sown very thin on the 21st of May, speedily sprang up, and the plants tillered so much that the beds put on the appearance of compact dense masses of vegetation; each plant having from ten to twenty off-sets. Although the blades grew vigorously, attaining in a short time to the length of two feet, there was never any symptom of a rising stem; and if the ground was not watered, either by rain or artificially every three or four days, the plants began to assume a sickly hue. In this manner vegetation proceeded, without, the smallest symptom of their perfecting themselves by fructification, when the plants were suddenly destroyed by an early night-frost in September. Some of the plants, which had been transferred to pots and placed in the hot-house at an early period of their growth, soon died; while others, which were sown originally in a hot-house, produced ears and flowered, but the blossoms dropped without perfecting any seed.

The conclusion to which Sir Joseph Banks arrived from these experiments was unfavourable to the cultivation of rice in this country as a grain-bearing plant; but he was led to consider, from the great quantity of its blades, that it would afford excellent green-meat for cattle.

Clammy rice appears to be endowed with the peculiar property of growing both on wet and on dry lands: the period occupied by its growth is intermediate between those of the common and early varieties.

Rice seed is sown in Carolina in rows, in the bottom of trenches, which are about eighteen inches apart,

reckoning from the centres of the trenches. The sowing is generally performed by negro women, who do not scatter the seed, but put it carefully into the ground with the hand, so as to preserve the perfect straightness of the line. The sowing is for the most part completed by the middle of March. The water, which until then has been kept back by means of flood-gates, is at this time permitted to overflow the ground to the depth of several inches, and things remain in this state for some days—generally about a week. The germination of the seed is promoted by this flooding, and the water being then drawn from the surface of the land, the plants sprout, rising in about four weeks to the height of three or four inches. At this time the flood-gates are again opened, the fields are once more overflowed, and remain in that state during about sixteen days; one good effect of this second flooding being the destruction of the grass and weeds which may have sprouted at the same time with the rice. The land is allowed after this to remain without further irrigation until the middle of July, being repeatedly hoed during the interval, as well to remove any weeds at the moment of their appearance, as to loosen the soil about the roots of the rice, adopting thus in all its principal parts the drill system of husbandry. At the time last mentioned, water is again admitted, and remains covering the surface until the grain is actually ripened.

The rice-harvest in the United States usually commences at the end of August, and extends through the entire month of September, or even somewhat later. The reaping is performed with a sickle by male negroes, and these are followed by females, who collect the rice into bundles.

This cultivation is found to be extremely unhealthy to the negroes employed in its prosecution. The alternate flooding and drying of the land in so hot a climate, where natural evaporation proceeds with great rapidity, must necessarily be prejudicial to health. To avoid exposure to this unwholesome atmosphere, the whole white population abandon the low grounds to the care

of negro cultivators. The mortality thus occasioned among the labourers in rice districts is so great, that while the general increase of population in the States exceeds by far that realized in the older settled countries of Europe, fresh supplies of negro slaves must continually be brought, to repair the waste of life, from the more northern slave-states of the Union.

The cultivation of rice is very extensively and successfully carried on in the rich meadows of Lombardy, which can be irrigated by the waters of the Po. The meadows chosen for the purpose are perfectly flat. After the seed is sown, the water is turned on and allowed to cover the surface to the depth of several inches during the whole course of its growth, and until the rice is ripe. Three crops are taken successively from the ground in this manner without manuring: but the soil is then so far exhausted, that it must be manured and planted for a time with other crops before another succession of rice-harvests can be drawn from it.

This system of agriculture proves the most profitable to the cultivator of any that is carried on in Lombardy; but the same unwholesome effect is experienced there as in Carolina; and the government at Milan finds it expedient to restrict the cultivation within a certain limit, beyond which the production of rice is not allowed. The quantity of seed usually sown is three bushels to the acre, and the average produce, from the same measure of land, is commonly about six quarters.

In the province of Valencia in Spain, the method of rice-cultivation is very similar to that pursued in Lombardy. The water remains on the ground even during the operations of harvest, and the reapers are obliged to wade up to their knees in order to cut the grain, other persons following to receive the sheaves as they are cut, and to convey them to some dry place, where the grain is detached from the ear by the treading of mules.

The hollows between Columbo and Candy, in the island of Ceylon, are devoted to the production of rice. The fields on which it is sown are artificially formed

into a regular succession of terraces, one above another, so that the water of irrigation may be made to flow from a higher to a lower level, the plants being in different stages of their growth. In some cases the water is led for a mile or even two miles, along the side of a mountain, and is then discharged over the highest terrace, and thence downward in succession to the lowest, according as moisture may be required by each. Bishop Heber, for whom the charms of nature, whether in a wild or cultivated state, were never displayed in vain, remarks, on visiting this district, that "the verdure of the young rice is particularly fine, and the fields are really a beautiful sight, when surrounded by and contrasted with the magnificent mountain scenery."*

The cultivators of rice in America sometimes suffer severely from the depredations of the *rice-bird* of Catesby (*Emberiza oryzivora*), known familiarly in the country by the name of Bob Lincoln. This bird is about six or seven inches long; its head and the under part of its body are black, the upper part is a mixture of black, white, and yellow, and the legs are red. Immense flocks of these birds are seen in the island of Cuba, where the rice-crop precedes that of Carolina; but when from the hardening of the grain the rice in that quarter is no longer agreeable to them, they migrate towards the north, and pass over the sea in such numerous parties, as to be sometimes heard in their flights by sailors frequenting that course. These birds appear in Carolina while the rice is yet milky. Their attacks upon the grain while in this state are so destructive as to bring considerable loss upon the farmers. The birds arrive in the United States very lean, but thrive so well upon their favourite diet, that during the three weeks to which their visit is usually limited, they become excessively fat, so as to fly with difficulty, and when shot to burst with the fall. So soon as the rice begins to harden here, they retire to other parts, remaining in one place only so long as the rice con-

* Heber's 'Journey,' vol. iii. p. 169.

Rice-birds, Male and Female

tinues green. When this food entirely fails, they have recourse for their subsistence to insects, until the maize begins to form its grains, and then the milky substance which these contain is devoured with the same avidity that marks their attacks upon the rice-plant. Extensive flocks of the oryzivora are found during the spring and summer in New York and Rhode Island; there they breed, quitting with their young for the southward, in time for the tender rice-grains of Cuba. It is remarkable that the males and females do not migrate in company, the females being always the first to perform their voyages. These birds are eaten as a great delicacy, and the song of the male is said to be melodious.

The uses to which rice is actually applied may be easily defined. In a great part of India and China it forms the subsistence of the native population, more exclusively and to a greater extent than can perhaps be said of any other vegetable substance in any known region of the globe. In the countries just mentioned, as well as those districts of Africa where it is used indiscriminately with maize, rice undergoes but little culinary preparation, being, for the most part, simply boiled with water, and eaten either by itself, or accompanied by some stimulating or oily substance. In countries, on the other hand, where it is employed only as an auxiliary article of food, rice is subjected to a greater degree of preparation for the table, and except when used to thicken broths, is seldom presented, unless after concoction with eggs, and milk, and sugar, which cover the natural insipidity of the grain.

In years when the harvest is deficient in this country, it is usual to hear a great deal about the practicability and advantage of mixing rice with wheaten or rye flour for making bread, and this may, without doubt, be done in a certain moderate proportion; such bread, however, speedily becomes harsh and dry. A writer in the *Journal des Sciences, des Lettres, et des Arts*, has, indeed, given directions, by following which, it is said, fermented bread may be made of rice without admixture with the flour of any other grain. The method is as follows:—First reduce the rice to powder in a mill, or throw the whole grains into water at nearly a boiling heat, and allow them to soak during some hours. Then drain off the water, and when the rice shall have become sufficiently dry, beat it in a mortar, and pass the powder through a fine sieve. This flour must next be placed in a kneading-trough, and moistened in the necessary degree with water rendered glutinous by boiling whole rice in it for some time; add salt, and the proper quantity of leaven or yeast, and knead the whole intimately together. The dough must then be covered with warm cloths and left to rise. During this fermentative process, the dough, which was of a pretty firm consistence, will

become so soft as not to be capable of being formed into loaves. It is, therefore, placed in the requisite quantities in tin forms, and these being covered with large leaves, or with sheets of paper, are introduced into the oven, the heat of which speedily sets the dough sufficiently, so that the tins being reversed, their contents are turned out upon the leaves or paper. The bread, when perfectly baked, will be of a fine yellow colour, similar to that imparted to flour by the yolks of eggs, and when new is said to be sufficiently agreeable.

We are told that the Chinese make a kind of wine of rice, which resembles, both in colour and flavour, the white wine of Xeres; but it is not known by what process they are enabled to succeed in this manufacture. In the East, considerable quantities of ardent spirit are extracted from this grain by fermentation and distillation.

It has been declared impracticable to manufacture beer from rice, in consequence of the difficulty which attends its previous conversion into malt. M. Dubrunfaut has stated that this necessary process may be readily and completely accomplished in the mash-tub by mixing one part, by weight, of malted barley with four parts of crushed rice which has previously been mixed with its own weight of water. The ready formed saccharine matter of the barley malt appears to have the singular property of speedily converting the fecula of unmalted corn into a kind of soluble matter which has the fermentative properties of sugar. If malt and rice flour, diluted so as to have a pasty consistence, be mixed and mashed together, and then left during three or four hours, the mixture will present the appearance of a liquid which is slightly saccharine to the taste, and having a sediment at the bottom of the vessel, which is found, on examination, to be composed of only the husks of barley and rice. M. Dubrunfaut used for the purpose rice from which the husk had not been removed previous to its being crushed, and which in this state is known by the name of *paddy*, or more properly *paddee*.

The practice has obtained very much, during the last

few years, of importing this paddee, in preference to shelled rice, its cost being lower in foreign markets, and the importers avoiding a very large proportion of the customs' duty chargeable on that already prepared for use. Some very effective machinery has been set up for the purpose of removing the husk and cuticle, and these operations are performed full as perfectly, and with less breaking of the grains than follows the employment of the ruder methods usually pursued in the countries of production; the loss, by waste, is also found to be less on the transport of paddee than of shelled rice.

CHAPTER VI.

MAIZE—MILLET—BUCK-WHEAT.

Maize—*Zea Mays*.

MAIZE, or INDIAN CORN (*Zea Mays*). Of this plant only one species is generally cultivated, but there are several varieties which are thought to owe their distinctive character to the accidental modifications of climate, soil, and culture,

rather than to any original variance. The plant consists of a strong, reedy, jointed stalk, provided with large alternate leaves, almost like flags, springing from every joint. The top produces a bunch of male flowers, of various colours, which is called the *tassel*. Each plant bears, likewise, one or more spikes or *ears*, seldom so few as one, and rarely more than four or five, the most usual number being three: as many as seven have been seen occasionally on one stalk. These ears proceed from the stalk at various distances from the ground, and are closely enveloped by several thin leaves, forming a sheath, which is called the *husk*. The ears consist of a cylindrical substance, of the nature of pith, which is called the *cobb*, over the entire surface of which the seeds are ranged, and fixed in eight or more straight rows, each row having generally as many as thirty or more seeds. The eyes or germs of the seeds are in nearly radial lines from the centre of the cylinder; from these eyes proceed individual filaments of a silky appearance, and of a bright green colour; the aggregate of these hang out from the point of the husk, in a thick cluster, and in this state are called the *silk*. It is the office of these filaments, which are the stigmata, to receive the farina, which drops from the flowers on the top, or tassel, and without which the ears would produce no seed—a fact which has been established by cutting off the top previous to the development of its flowers, when the ears proved wholly barren. So soon as their office has been thus performed, both the tassel and the silk dry up, and put on a withered appearance.

The grains of maize are of different colours, the prevailing hue being yellow, of various shades, sometimes approaching to white, and at other times deepening to red. Some are of a deep chocolate colour, others greenish or olive-coloured, and even the same ears will sometimes contain grains of different colours.

Unlike the cereal grains which have been already described, naturalists are at no loss in determining the native region of maize, which is confidently held to be America, the Indians throughout that continent having

been found engaged in its cultivation at the period when the New World was first discovered.

This grain is of scarcely less importance than rice for the sustenance of man. It forms a principal food of the rapidly increasing inhabitants of the United States of America; it constitutes almost the entire support of the Mexicans; and is consumed in Africa to an extent nearly, if not quite, equal to the consumption of rice in the same quarter.

The merits of Indian corn have been very differently estimated; and while some persons have invested it with a value equal, if not superior, to that possessed by the rest of the cerealia, other persons have, on the contrary, placed it at the lowest station among the family, scarcely, indeed, allowing it worthy to take its place in the group. Without meaning in any way to involve the reader in this controversy, it is yet necessary to set fairly before him the facts connected with the question, and he may then be enabled to form a correct judgment on the matter.

It is seen that domestic animals which are fed with maize very speedily become fat, their flesh being at the same time remarkably firm. Horses which consume this corn are enabled to perform their full portion of labour, are exceedingly hardy, and require but little care; and the common people of countries where Indian corn forms the ordinary food, are for the most part strong and hardy races. The produce of maize, on a given extent of cultivation, is greater than that of any other grain; and the proportional return for the quantity of seed committed to the ground is equally advantageous.

No argument can be founded either way upon the liking or disliking of individuals. Man is in this, as well as in most other respects, very much the creature of habit, and preferences, both national and individual, are often shown by him, in regard to articles of food, which would be wholly incomprehensible upon any other ground. We need not go beyond the bounds of Europe for abundant proofs of this fact, if indeed such are not offered by our own personal observation. It falls within the knowledge

of the writer that a gentleman, who, in his boyish days, had been nurtured in a village on the coast, in a remote part of Scotland, acquired such a fondness for some weed thrown up by the sea, and which through the poverty of the inhabitants was made to form part of their sustenance, that in after-life, and when he had returned from a protracted residence abroad, he procured a supply of his favourite weed to be regularly sent to him in London, and ate as the greatest delicacy that upon which the members of his family could only look with disgust.

Of all the cerealia, maize is the least subject to disease. Blight, mildew, or rust, are unknown to it. It is never liable to be beaten down by rain, or by the most violent storms of wind; and in climates and seasons which are favourable to its growth and maturity, the only enemies which the maize farmer has to dread are insects in the early stages, and birds in the later periods of its cultivation.

American Indian Corn is the largest known variety of maize. It is found growing wild in many of the West Indian islands, as well as in the central parts of America; and there can be no doubt of its being a native of those regions. In favourable situations it has a very considerable growth, attaining to the height of from seven to ten feet; in some cases it has acquired the gigantic height of fourteen feet, without in any way impairing its productive power. Its spike, or ear, is eight or ten inches in length, and five or six inches in circumference. The plant generally sends out one, two, or more suckers from the bottom of the stalk; but these it is advisable to remove, not only as they draw away part of the nourishment which should go to support the main stalk, but because the ears which the suckers bear ripen at later periods than the others, and the harvest could not all be simultaneously secured in the properest state of maturity.

This variety will rarely come to maturity in northern climates, and could never be securely relied on for a crop in any part of Europe. In the Mexican states, where this grain is known by the name of *Tlaouili*, there are few parts of either the lower districts—*tierra caliente*—

or of the table-land, whereon it is not successfully cultivated. In the former districts its growth is naturally more luxuriant than in the latter; but even at an elevation of six or seven thousand feet above the level of the sea its productiveness is calculated to excite wonder, if not to provoke incredulity on the part of European agriculturists. Some particularly favoured spots have been known to yield an increase of eight hundred for one; and it is perfectly common in situations where artificial irrigation is practised, to gather from three hundred and fifty to four hundred measures of grain for every one measure that has been sown. In other places, where reliance is placed only on the natural supply of moisture to the soil from the periodical rains such an abundant return is not expected; but even then, and in the least fertile spots, it is rare for the cultivator to realize less than from forty to sixty bushels for each one sown.

The system of husbandry employed is closely analogous to that already referred to as Tull's Horse-hoeing Plan. The seed is sown, from three to five grains together, at regular intervals, of three feet, in rows sufficiently far apart to admit of the passage of a small plough between them, for the purposes of loosening the soil around the roots and of removing the weeds. The use of manure is altogether unknown in Mexican maize husbandry.

Humboldt states that in some warm and humid regions of Mexico three harvests of maize may be annually gathered, but that it is not usual to take more than one. The seed-time is from the middle of June to near the end of August. A great part of the internal commerce of Mexico consists in the transmission of this grain, the price of which varies considerably in not very distant stations, owing to the imperfect state of the roads, and the insufficient means of transport. As an instance of this, Humboldt mentions the fact, that during his stay in the intendancy of Guanaxuato, the fanega (five bushels) of maize cost at Salamanca nine, at Queretaro twelve, and San Luiz Potosi twenty-two, livres. For want of a proper diffusion of commercial capital, the Mexican public is without the advantage of magazines for storing corn,

and for preventing, by that means, great fluctuations in price. It is a fortunate circumstance, and one which should be mentioned as adding very materially to the natural value of maize in warm climates, that it will remain in store uninjured for periods varying from three to five years, according to the mean temperature of the district.

This kind of corn is generally planted in the United States of America about the middle of May, so as to avoid the mischance of its experiencing frost after it is once out of the ground. The Indians who inhabited the country previously to the formation of any settlement upon its shores by Europeans, having no calendar or other means of calculating the efflux of time, were guided by certain natural indications in their choice of periods for agricultural operations. The time for their sowing of maize was governed by the budding of some particular tree, and by the visits of a certain fish to their waters—both which events observation had proved to be such regular indicators of the season, as fully to warrant the faith which was placed on their recurrence. These simple and untaught people discovered and practised a method of preserving their grain after harvest, which afforded a certain protection against the ravages of insects, and which might be advantageously adopted in other situations, and in climates where this evil is very prevalent. Their method was to separate the corn from the cobb as soon as the harvest was finished; to dry it thoroughly by exposure to the sun, and to a current of air; and then to deposit it in holes dug out of the earth in dry situations, lining these holes with mats of dried grass, and covering them with earth, so as completely to prevent the access of air.

With the exception of artificial irigation, to which recourse is not had in the United States, the method of sowing and managing maize is there singularly analogous to that pursued in Mexico. The proportionate produce, from a given quantity of seed or a certain breadth of land, is smaller, however, than that realized in Mexico, although the practice of manuring is universally followed.

As compared with the yielding of other kinds of grain, maize cultivation is, nevertheless, highly productive in the United States. In Pennsylvania, where the average crop of wheat does not exceed from fourteen to seventeen bushels, that of maize amounts to from twenty to thirty bushels to the acre. A writer in the 'Monthly American Journal of Geology and Natural Science' considers that maize produces the heaviest crops near the northern limits of its range. The American farmers find this advantage to attend the partial culture of maize upon their farms, that the time of harvesting is some weeks later than that of wheat, and that, consequently, the general operations of the harvest may be conducted without great bustle and temporary advance of wages, to be followed by a season of inaction, and consequently of idleness, to the labourer—evils which are commonly experienced in England.

The second variety of maize has white grains. This kind, which is cultivated in Spain, Portugal, and Lombardy, is altogether a smaller plant than the variety just described, seldom exceeding six or seven feet in height: the leaves are narrower, and the tops hang downwards. The ears or spikes are not more than six or seven inches long. The French, among whom this grain is partially cultivated, have given to it the name of Blé de Turquie, doubtless because their seed was originally obtained from that country.

Except in unusually favourable seasons, the two varieties hitherto described will not come to maturity in England, although they are sometimes sown as a curiosity in warm spots in gardens.

The third variety has both yellow and white seeds. It is even smaller than the last-mentioned, seldom rising to a greater height than four feet: the ears do not often exceed four or five inches in length. In ordinary seasons it will ripen its grains perfectly in England; and one reason why it has been presumed that its cultivation would prove advantageous to this country, is the shortness of time required for its growth, whereby the late frosts to which we are sometimes liable in spring, and the

early frosts of autumn, would be alike avoided. This particular variety is cultivated in some of the middle regions of the European continent, as well as in some parts of North America, from which latter country it is understood to have its origin. It is also partially cultivated in Germany, not as a bread-corn, but that it may be malted and used in the preparation of a kind of beer, or made to yield an ardent spirit. The use chiefly made of it, however, is that of fattening swine and poultry.

In the cultivation of Indian corn in northern climates, it is proper to make choice of warm spots, and particularly to avoid shady situations. In order to admit the sun as much as possible to the plants, and probably also with the view of affording more nutriment to the grain, it is usual to remove the blades, together with the top and tassel, as soon as its office of dropping its fecundating farina upon the ears has been fully accomplished. This process is very easy of performance: when the blades and tops are perfectly dry they are stacked and thatched, and form an excellent substitute for hay and chaff in the spring, both for cattle and horses, as well as for sheep, all these animals being attracted by its sweetness.

It may generally be known when the corn is ripened by the dry and white appearance put on by the husk: a more intimate inspection is, however, accomplished without difficulty. The ears must then be plucked off, together with the husks, and conveyed at once in carts to the barn. In America the stalks are usually left standing for some time longer. Being then cut near to the ground, tied up into bundles, and stacked in a dry place, they will prove useful as food for horned cattle, which, from the saccharine quality of the plants, will thrive upon them.

The ears are preserved in bins or cages which are called corn-cribs, sometimes with the husk and at other times without it, and it is not considered good farming to shell the corn before it is required to be sent to market. This operation of shelling is very easily performed. The only implement required for the purpose is a piece of iron in shape like a sword-blade, the edge of which is

Ears of Maize in different stages.

not sharp, and this iron being fixed across the top of a tub in which the shelled grains are to be collected, the ear is taken in both hands and scraped lengthwise smartly across the edge of the iron until all the grains are removed. In this manner, it is said, an industrious man will shell from twenty to twenty-five bushels of corn in the course of the day. The cobb which remains makes a very tolerable quick-burning fuel, and thus no part of the plant proves altogether without use.

The grain forms one-half the measure of the ear, that is to say, two bushels of ears will yield one bushel of shelled corn. So correct is this estimate found to be, that in the markets of the United States, where Indian

corn is sold both shelled and with the cobb, two bushels of the latter are taken without question by the purchaser, as being equal to one bushel of shelled grain.

An amusing, and in many respects an instructive, book was published a few years since upon the merits of Indian corn, by one whose sanguine wishes upon the subject of its introduction as a corn-plant into England led him farther than most people have been inclined to accompany him. There is to be seen in the work here referred to a very minute and interesting account of all the various processes which must be attended to by the maize-grower before his grain is ready for sale, as well as very minute directions for turning the produce to the best and most agreeable account in family economy.* Although the public mind seems at present to be differently impressed upon the matter, it does not appear very improbable that some hardy variety of this plant may, at no very distant day, be regularly cultivated in some parts, at least, of England and in Ireland. Sir Richard Bulkeley, who obtained some seed from Brandenburgh, sowed it in the last-mentioned island, and it is recorded that his produce was exceedingly great, fully equal, indeed, to anything asserted of Mexican fecundity. Might not this grain be gradually introduced, to the advantage of that portion of the kingdom, affording to the peasantry a more nourishing food than that upon which the bulk of them are now constrained to subsist? That Indian corn is well qualified to form the entire food—if that were necessary—of a people, is amply exemplified by the Mexicans, the great bulk of whom seldom partake of any other description.

Captain Lyon, in the narrative of his travels in Mexico, has given an amusing account of the mode of preparing *tortillas*, a species of cake made with the crushed grains of maize, which is eaten hot at the meals of all classes of people, the more wealthy using the cakes in the way we are accustomed to use wheaten bread—as an auxiliary to more nourishing aliments — and the peasants being fain

* 'A Treatise on Cobbett's Corn,' by W. Cobbett.

to enjoy them as a substantive food, seasoning them, when they have the opportunity, by the addition of chilies stewed into a kind of sauce, wherein the tortillas are dipped. Simple as the art may appear of thus making an unleavened cake with moistened flour, some persons are found to acquire a greater degree of expertness in it than others; and so great is the necessity for their preparation, and the desire of having them well concocted, that according to Captain Lyon, "in the houses of respectable people, a woman, called from her office Tortillera, is kept for the express purpose; and it sounds very oddly to the ear of a stranger during meal-times, to hear the rapid patting and clapping which goes forward in the cooking-place, until all demands are satisfied."*

The various uses to which the maize plant and grain may be applied cannot, perhaps, be better enumerated than in the words of Dr. Franklin, a man accustomed to make a sober estimate upon every subject that fell under his observation; and who, however enthusiastic he might be in the cause of virtue and rational freedom, never suffered himself to be betrayed into exaggeration, or to be carried away by a too sanguine imagination in affairs connected with the business of life.

"It is remarked in North America, that the English farmers, when they first arrive there, finding a soil and climate proper for the husbandry they have been accustomed to, and particularly suitable for raising wheat, despise and neglect the culture of maize and Indian corn; but observing the advantage it affords their neighbours, the older inhabitants, they by degrees get more and more into the practice of raising it; and the face of the country shows from time to time that the culture of that grain goes on visibly augmenting.

"The inducements are, the many different ways in which it may be prepared so as to afford a wholesome and pleasing nourishment to men and other animals. First, the family can begin to make use of it before the time of full harvest; for the tender green ears, stripped

* Lyon's 'Mexico,' vol. ii. p. 136.

of their leaves, and roasted by a quick fire till the grain is brown, and eaten with a little salt or butter, are a delicacy. Secondly, when the grain is riper and harder, the ears, boiled in their leaves and eaten with butter, are also good and agreeable food. The tender green grains dried may be kept all the year, and, mixed with green *haricots* (kidney beans), also dried, make at any time a pleasing dish, being first soaked some hours in water, and then boiled. When the grain is ripe and hard there are also several ways of using it. One is, to soak it all night in a *lessive* or lye, and then pound it in a large wooden mortar with a wooden pestle; the skin of each grain is by that means skinned off, and the farinaceous part left whole, which being boiled, swells into a white soft pulp, and eaten with milk, or with butter and sugar, is delicious. The dry grain is also sometimes ground loosely, so as to be broken into pieces of the size of rice, and being winnowed to separate the bran, it is then boiled and eaten with turkies or other fowls, as rice. Ground into a finer meal, they make of it, by boiling, a hasty pudding or *houilli*, to be eaten with milk, or with butter and sugar; this resembles what the Italians call *polenta*. They make of the same meal, with water and salt, a hasty cake, which being stuck against a hoe or other flat iron, is placed erect before the fire, and so baked to be used as bread. Broth is also agreeably thickened with the same meal. They also parch it in this manner. An iron pot is filled with sand, and set on the fire till the sand is very hot; two or three pounds of the grain are then thrown in, and well mixed with the sand by stirring; each grain bursts and throws out a white substance of twice its bigness; the sand is separated by a wire sieve, and returned into the pot to be again heated, and the operation is repeated with fresh grain; that which is parched is pounded to a powder in mortars. This, being sifted, will keep long for use. An Indian will travel far and subsist long on a small bag of it, taking only six or eight ounces of it per day mixed with water. The flour of maize, mixed with that of wheat, makes excellent bread, sweeter and more agreeable than that of wheat

alone." To feed horses, it is good to soak the grain twelve hours; they mash it easier with their teeth, and it yields them more nourishment. The leaves stripped off the stalks after the grain is ripe, tied up in bundles when dry, are excellent forage for horses, cows, &c. The stalks, pressed like sugar-cane, yield a sweet juice, which being fermented and distilled, yields an excellent spirit; boiled without fermentation, it affords a pleasant syrup. In Mexico fields are sown with it thick, that multitudes of small stalks may arise, which being cut from time to time, like asparagus, are served in desserts, and thin sweet juice extracted in the mouth by chewing them. The meal wetted is excellent food for young chickens, and the old grain for grown fowls." *

In addition to the many uses enumerated by Franklin in the foregoing account, Humboldt acquaints us that the Mexican Indians, previous to the conquest of their country, were accustomed not only to express the sweet juice from maize-stalks for the purpose of fermenting it into an intoxicating liquor, but that they boiled down this juice to the consistence of syrup, giving it likewise as his opinion that they were able even to make sugar from this inspissated juice. In confirmation of this opinion he recites a letter written by Cortez, who, in describing to the emperor Charles V. the various productions in both a natural and manufactured state which he found in the new country, asserts that among these were seen "honey of bees and wax, honey from the stalks of maize, which are as sweet as sugar-cane, and honey from a shrub which the people call magney. The natives make sugar from these plants, and this sugar they also sell." That this is truly the case there can be no doubt, as it has been recently proposed to manufacture sugar from the stalks of maize; and Professor Croft, of Toronto, in a communication made to the Linnæan Society in February, 1843, gave the result of some experiments that had been made in Indiana. The sugar is separated from the sap, which is obtained from the plants previous

* Franklin's 'Works,' vol. ii. pp. 276-8, 4to. edit. 1818.

to the development of the flowers. From the experiments made in Indiana it appears that the juice of the maize-stalks contains more than three times as much sugar as that of the beet, and five times as much as that of the maple, and frequently exceeds the quantity obtained from the ordinary sugar-cane. The preparation of the sugar from the maize is represented as an easier process than that from the sugar-cane. Another advantage is that the maize comes earlier to perfection than the sugar cane, the juice being ready for use from the former at the end of from seventy to ninety days, whilst the latter requires eighteen months.

The sugar of the maize is capable of fermentation, and the Indians of Mexico are in the habit of preparing from the juice several fermented liquors. They are generally known by the name of *chicha*, and, according to Humboldt, some of them resemble beer, whilst others are like cyder. The spirituous liquor called *pulque de mahis*, or *tlaomili*, is prepared from the maize, and in some parts of the republic of Mexico it forms a very important article of commerce.

From the analysis of the fruit of maize, and after the above statements, there can be no doubt that it is a valuable article of diet. During the apprehended scarcity of the potato in Ireland, there can be no question that it might be made to form a valuable substitute for that tuber, although not so nutritious as wheat, barley, or oats.

MILLET—Species of *Sorghum* and *Setaria*. These are true grasses, and naturally allied to one of the most numerous tribes. In light sandy soils, under the scorching rays of the sun, and in situations where sufficient moisture cannot be obtained for the production of rice, millet is successfully cultivated. Sorghum forms a chief dependance of the people in some parts of India; through the arid districts of Arabia, in Syria, where it has been produced from the earliest periods; and in Nubia, whose inhabitants cultivate this almost to the exclusion of every other grain.

The seeds of panicled millet are by much the smallest of any of the cereal plants, but the number borne upon

each stalk is so exceedingly great as to counterbalance that disadvantage, and to render this equally productive with other of the culmiferous plants: it is to this circumstance that its name, from *mille*, a thousand, has been ascribed.

Of this sort there are two modifications, distinguished by the form of their spike, one being composed of a single rachis, while the other is very much branched. The difference of form thus exhibited is of so marked a character that it can scarcely be viewed as a modification brought about by difference of culture.

Of each of these there are to be found some species which chiefly exhibit themselves as such by the varying colour of their grains, and by the circumstance of these being either naked or encrusted.

One kind of millet, the spike of which is compact, has been supposed to be a native of the north of Europe, and is commonly known, at least in this quarter of the globe, as GERMAN MILLET (*Setaria Germanica*). It is thought, however, that this variety was originally imported from India and acclimatized in Germany. Nor does it afford any direct evidence against this opinion that seeds apparently of the same kind, brought from India, and subjected at once to the same culture, do not perfect their seeds; since it is well known that the habits of plants may be changed by slow degrees to an extent quite sufficient to account for this variance. The stalk of this, and indeed of all the varieties of millet, resembles a jointed reed, having at every joint a long broad leaf embracing the stalk with its case. This variety rises to the height of three or four feet, and terminates in a compact spike about eight or nine inches long, somewhat thicker at the base than at the top, beset with small round grains, which adhere but slightly to the husk, and therefore are very liable to be shaken out when ripe. The use principally made of this grain is the feeding of poultry.

ITALIAN MILLET (*Setaria Italica*) bears a considerable resemblance to the variety just described. This variety is decidedly a native of India, where it bears the

Italian Millet (*Setaria Italica*).

name of *conque*. The plant is stronger, the spike and the seed are larger, and, to bring it to maturity, requires a warmer climate than suffices for German millet. The use to which this grain is brought in Tuscany is that of feeding domestic fowls and animals, including horses. The larger species of animals are also fed upon the leaves and culms, of which last-mentioned portion brushes are likewise made. The Italians also make from the flour a kind of bread, which is dark-coloured and coarse. Like those of maize, the seeds of both these varieties are of various colours.

PANICLED MILLET is the species most usually cultivated. The commonest variety, which botanists call *Sorghum vulgare*, is known by various names in the

different districts where it is grown. In India it is called *jovaree;* in Egypt and Nubia, *dhourra;* while in our West Indian colonies it has received the name of *Guinea corn*, either because the seed was first conveyed thither from the western coast of Africa, or, as some persons have affirmed, because of its extensive use in feeding the African negroes throughout those colonies. The height to which this plant attains varies according to the soil and culture. In Egypt its growth seldom exceeds five or six feet, while Burckhardt* speaks of the stalks of dhourra as being sixteen or twenty feet long. The leaves are thirty inches long, and two inches wide in the broadest part. The flowers, when they first come out in large panicles at the top of the stalk, resemble the male spikes of the maize plant. These flowers are succeeded by roundish seeds, the colour of which is, in some cases, a milky white, with a black umbilical dot; in others the seeds are red, but in both cases they are wrapped round with the chaff, and are better protected from feathered depredators than other kinds of millet.

This grain was introduced into cultivation in Switzerland about the middle of the last century by M. Tschiffeli, who received about a spoonful of the seed from Dr. Schreber. M. Tschiffeli published an account of his method of cultivation in the Transactions of the Berne Society, some extracts from which paper will suffice to show the capabilities of this grain when cultivated in northern latitudes. Among the advantages which it offers are stated its adaptation to all sorts of soils, the small quantity of manure which it requires, the trifling amount of labour for which it calls, and the small degree of exhaustion which it occasions to the soil, in comparison with the largeness of the return which it yields.

M. Tschiffeli sowed his first seed in the month of May, on a gravelly soil exposed to the north wind, and which the year before had borne a very indifferent crop of bigg. The seed was spread very thin, and to this

* 'Travels in Nubia,' p. 280.

circumstance he attributed the fact that the stalks rose to the height of eight feet and upwards. The ears were above ten inches long, and but for an inopportune shower of hail which destroyed half the seed, the spoonful would probably have been multiplied into a peck of grains. In May of the following year, about a quart of seed was sown upon a piece of ground twenty paces long and half as broad, which space, it was soon apparent, was far too circumscribed for the quantity of seed. The stalks came up very close, and were interwoven with each other, reaching scarcely to the height of five feet, and the ears were much smaller than those of the preceding year. The produce, however, was seven pecks, or equivalent to fifty-six for one. In the next year thirty square rods of land were sowed with half a peck of the seed. Here again the millet came up far too thick, being almost as much crowded, from its greater tillering, as it was in the preceding year; notwithstanding which the produce was so great that twenty bushels were harvested, being a return of one hundred and sixty for one, and at the rate of more than one hundred bushels to the acre. M. Tschiffeli was of opinion that ten pounds of seed would prove an ample allowance for an acre of ground, and that greater space being thus allowed for the individual plants, the proportion between the quantities sown and harvested would be still more favourable. It does not appear that millet has ever been subjected to the system of drill husbandry, although the results here given seem to point out that system as being peculiarly applicable to its cultivation.

Sorghum is cultivated largely in some parts of China and in Cochin China. In England the autumn is rarely sufficiently dry and warm for ripening its seeds, otherwise the plant might prove useful in some poor and light soils, the produce of which is ordinarily insufficient to repay the greater expense attendant upon the cultivation of other grain. Sorghum was raised in this country as a rare plant, in the garden of John Gerarde, as early as 1596.

The golden-coloured millet-seeds seen in our grocers' shops are the produce of the *Sorghum saccharatum*, or

yellow-seeded millet. Use is made of these in a similar manner with rice, for the preparation of puddings.

This variety is likewise a native of India; it is cultivated largely in China and Cochin China; and has been introduced into the island of Jamaica. Philip Miller reared it in his garden in 1759.

In warm climates millet is usually sown in May and June, and perfects its seeds within four months. The plant is not subject to blight, nor is it easily injured by either drought or rain. The only care required in its cultivation is to allow sufficient space for the tillering of the plants, and to weed and hoe the intervals during the early part of the growth; after which it will overtop and smother all weeds.

When millet is ripe, the panicles are cut off near to the top of the stalk, and collected in sacks or baskets. They are then laid up in heaps, and carefully covered during five or six days; after which they are spread on the barn floor, and the grain is threshed out in the ordinary manner with a flail. The more primitive method of treading out the grain by means of oxen is resorted to in some parts of India.

If millet is not perfectly dry when deposited in the granary it will soon be spoiled; but, on the other hand, if this precaution be properly taken, there is no grain that will keep longer or better. The weevil will not touch it, and although it is doubtless the better for being turned over occasionally, that process, so indispensable with other grain, may be omitted here without producing any serious injury. In addition to the use made of the stalks as fodder, the Nubians employ them in the construction of temporary huts.

In the barren districts of Bornou a species of millet is produced, which is called by the inhabitants *gussub*, and upon which both men and animals are almost exclusively fed. By the poorer class it is frequently eaten, simply parched, or even without any culinary preparation. Other persons crush and then steep the seeds in water previous to eating them; and some few, who are the epicures of the land, clear the grain from the husk,

pound it, and make it up into a light paste with melted fat: this favourite dish is called *kaddul*.

Travellers who have visited the central parts of Africa complain much of a grievous annoyance to which they were there subjected from the prickles of a grass which grows wild and in great abundance, particularly in the neighbourhood of water. "These prickles are of the finest and most penetrating sharpness that can be imagined; they attach themselves to every part of the dress, and so small are the points that it is impossible to extract them without breaking and leaving a part behind."* The seed from this grass, which is called *kaschia*, is parched, broken, cleared from the husk, and, when boiled, is eaten in the manner of rice. When previously made into flour, kaschia is considered to be a great luxury.

The Nubians are accustomed to prepare a fermented liquor from dhourra; this, which they call *bouzah*, is considered by them as a very wholesome and nutritious beverage.

THERF is one plant, the name of which seems to point it out as proper for receiving some notice in this place, although it has no natural affinity with the cerealia: and the seeds, which are rarely used as human food in any country, are never so employed in England. This plant is BUCK-WHEAT (*Polygonum Fagopyrum*, Smith; *Fagopyrum esculentum*, Mœnch); also frequently called *brank*. The name given to this plant in Germany, where it is most cultivated, is *beech-wheat*, from the resemblance which the grains bear in shape to the mast or nuts of the beech-tree.

Buck-wheat is an annual plant, growing rather handsome, with branched herbaceous stems, having leaves which at first are roundish, but afterwards become arrow-shaped, resembling somewhat those of ivy, but being longer-pointed and much softer. The stalk is round and hollow; its general colour is green, but it sometimes has a reddish tinge; it commonly grows to

* Denham.

Buck-wheat (*Polygonum fagopyrum*).

the height of about thirty inches. At almost every joint of the stalk, lateral branches shoot out, which are terminated by purplish flowers, and these are succeeded by small triangular-shaped seeds, which are of a brownish-black colour on the outside, and white within. This grain is usually sown in May or June, and is of such rapid growth that it generally ripens its seeds within about one hundred days from the time of sowing. It will thrive in any soil, even in those which contain little else than sand. The largest increase is, however, obtained from dry ground, which has been thoroughly ploughed and pulverized; and in such circumstances as much as fifty or sixty bushels have been reaped from an acre on which only one bushel of seed has been bestowed.

This plant is more generally cultivated for the sake of its green fodder, and then the seed is strewn much thicker, as much as three or four bushels being allotted to the acre. If the season is forward, and the weather continues warm, buck-wheat may be sown for this purpose in April, and will bear cutting twice during the summer; but the slightest degree of frost will destroy it entirely. When it is thus intended to apply the plant as green meat, a sufficient quantity should be cut one day for the consumption of the next. The state most proper for cutting is when the blossoms are making their appearance.

All animals are fond of this food, and will thrive upon it. When given to cows it causes them to yield an abundance of excellent milk, which makes good butter and cheese. The stalk and leaves will continue green during the driest weather, even when all the grasses in the meadows are burnt up. The straw or haulm is sometimes given in a dry state to cattle, but is not then so useful as when green.

Buck-wheat is also sometimes sown in order that the plants may be ploughed into the ground, and serve as manure in the process of bringing lands into proper order for other crops. The time most proper for this ploughing is when the blossoms are full upon the plants, as they are then in their most succulent state. The land is then left at rest for some months, during which time the vegetable matter of the buck-wheat becomes fermented and decomposed. The plant known as Tartarian buck-wheat (*Polygonum Tartaricum*) being of more luxuriant growth than the common sort (*Fagopyrum esculentum*), has been preferably recommended for this object.

Birds are exceedingly fond of the seeds, and one of the principal uses made of them in this country is to feed pheasants during the winter, in spots set apart for the preservation of that species of game. With this object the grain is sometimes sown in these preserves, and left standing to afford both cover and food to the birds; at other times, the straw is taken unthreshed, and left in

heaps at intervals throughout the places where the birds resort. Such an abundance of their favourite food will not only prevent pheasants from rambling, but frequently allures others from spots where an equally comfortable provision is not made.

Horses are fond of the seeds, which are sometimes given to them in conjunction with oats; it is proper, however, in such case, to subject the buck-wheat to the previous operation of crushing. Pigs are often fattened upon buck-wheat, and it is said that if this food be given to them in great quantity at first, it will occasion the animals to exhibit symptoms of intoxication, so that they run squeaking and tumbling about in a grotesque manner. As they become habituated to the use of the grain, such an effect ceases. It is necessary to crush the seeds for this purpose also.

Buck-wheat is sometimes used by distillers, it being capable of yielding a considerable quantity of good spirit. This use is made of it to a great extent at Dantzig, where an extensive manufacture of cordial waters is continually carried on.

The poor of some countries mix the meal of buck-wheat with a small proportion of wheat-flour, and make a kind of bread of the compound, which is black and bitter, and deficient in a due degree of nourishment. In Brabant it is not unusual for persons who derive a profit from keeping bees to sow this grain near to their dwellings, they being of opinion that no plant is equal to it for affording to those insects a proper supply of materials whence their sweet store is elaborated.

CHAPTER VII.

CASEIN—LEGUMINOUS PLANTS.

The various forms of legumes or pulse, next to the cerealia, may be said to form the most important kind of food. It will be found from the analysis previously given, that the seeds of these plants, as peas, beans, lentils, &c., contain even more nitrogenous matters than the cerealia, and thus are more capable of supplying nutrition to the system. The nitrogenous principle found in the seeds of the Leguminosæ differs in some of its physical and chemical characters from that found in the cerealia, and from its being identical with the substance separated from milk under the name of cheese; it is called *casein*. Although these seeds contain so much nutritive matter, they are not under all circumstances the most nutritious food. This arises from the fact that casein is much less easily digested than fibrine or albumen. With animals, however, which can digest this substance, as the horse, the ox, &c., it is well known that peas and beans are the very best diet they can have to enable them to perform their labour.

The analysis to which we have referred, and to which these remarks apply, are of the ripened seeds of the Leguminosæ, but extensive use is made both of the unripened fruits and seeds of these plants. Thus the Windsor bean and green peas are eaten before the seeds are ripe, and the fruit of the French bean is eaten whilst it is green. Of course, in this state these plants contain much less nitrogenous matter and a much larger proportion of water than the ripened seeds.

The principal legumes cultivated in Britain are the pea, the bean, and the kidney-bean.

The species of pea (*Pisum*) are climbing plants, fur-

nished with tendrils at the terminations of the compound leaves; and none of the species, not even the dwarf kind, can sustain their stems in an upright position without either interlacing with each other, or clinging to some extraneous support.

The varieties of the species of this genus are very many. Botanists enumerate several species, which they regard as being distinct. The chief of these are the common or cultivated pea (*Pisum sativum*), the sea-pea (*Pisum maritimum*), the Cape Horn pea (*Pisum Americanum*), and the yellow flowering pea (*Pisum ochrus*). The first is the only one which is deemed eligible for cultivation in Britain. The sea-pea is a native of England, and now called by botanists *Lathyrus maritimus*.

The *Pisum Americanum* is a biennial plant which was found growing at Cape Horn by some of the people attached to Lord Anson's expedition. This fresh pulse was a most welcome addition to the ordinary sea provisions, and under such circumstances it appeared to be of more excelling flavour than the common pea. It was accordingly brought home and propagated, but was soon found not to equal even the worst sort of those which were already in cultivation, and it is now only preserved in botanical collections. The flowers are blue, each pedunicle sustaining four or five flowers, the pods taper, and the seeds are very small.

The yellow flowering pea is found in a wild state in the corn-fields of Sicily, and some parts of Italy, but is here merely preserved in botanic gardens for the sake of variety. The peduncles have but one flower each, and the pods and seeds are larger than those of the sea-pea. They are sometimes eaten, but they are coarse and of little value.

The native country of the common pea (*Pisum sativum*) is not known, it having been a cultivated vegetable before the commencement of botanical history. It is probable, however, that it was introduced into Britain from the warmer parts of Europe, and may have been brought to these from Egypt and Syria. It is known in India, China, and Cochin China; but it is not very

plentiful in those places, and there is no evidence of its being a native plant. It is more abundant in the Japan Isles, the climate and soil of which agree better with its habits; and therefore there is reason to conclude that it is not a native of very dry and burning regions; neither is it the offspring of very frigid climes, since it is soon affected by cold, severe weather, and the leaves become blackened by the autumnal frosts.

Historical evidence would make it appear that both the pea and the bean must not only have been introduced but extensively cultivated in some parts of Scotland, as well as in England, at a very early period. It is on record, that when the English forces were besieging a castle in Lothian, in the year 1299, their supply of provisions was exhausted, and their only resource was in the peas and beans of the surrounding fields. This circumstance would lead to a belief that the pea was then one of the staple articles of produce for human food.

The more delicate kinds, however, do not appear to have been cultivated in England until a much later period, since Fuller informs us that peas, in the time of Queen Elizabeth, were brought from Holland, and were "fit dainties for ladies, they came so far, and cost so dear." In the reign of Henry VIII., too, the pea would appear to be somewhat of a rarity, as in the Privy Purse Expenses of that king is an entry, "paied to a man in rewarde for bringing pescodds to the King's grace, iiijs. viiid." From a song, however, called 'London Lyckpeny,' made in the time of Henry VI., peascods appear to have been commonly sold in London:

> Then unto London I dyde me hye,
> Of all the land it beareth the pryse;
> 'Gode pescode,' one began to cry."

At Windsor there is a street called "Peascod," mentioned by that name in old documents.

The use of the pea as an esculent, both in its green and its dried state, is too familiar to need description. This plant is annually cultivated to a great extent in Britain; perhaps, since the more general introduction

of the potato, a diminution of peas culture may have taken place in the poorer districts; but peas are always in constant requisition in this country; they are consumed in immense quantities as sea provisions; they are likewise largely supplied to hospitals, infirmaries, and workhouses, and are in familiar use in every private family.

The principal varieties of the common pea are the white or yellow, and the grey. Soil and culture have probably produced all the varieties under the two sorts; different as they now are, both in their colours and their qualities, and even in the number of flowers and pods growing from each peduncle.

Among grey peas, where much attention has not been paid to the purity of the seed, it is not unusual to find several shades of colour from a deep purple almost approaching to a black, to a very pale or nearly white hue. In even the same parcel, some seeds are grey, some mottled, and others purple.

The white and yellow peas are distinguished as garden peas and field peas. The former being the choice sorts, are raised by more careful and expensive culture for the purpose of being eaten green; the latter, inferior chiefly on account of the manner of their being raised, are allowed to come to maturity.

The sub-varieties of the common pea are never-ending. These have obtained their names, some from imaginary qualities, some from the peculiar mode of culture, others from the persons who first produced them, and some from more fanciful distinctions. Of those no less than twenty-two are enumerated as being objects of garden culture, differing in the colour of the flowers, height of the haulm or stalk, time of coming to maturity, produce of legumes, or size and flavour of the seeds. The varieties are in different degrees tender or hardy; if, then, a due regard be paid to the choice of soil and situation, and the time of sowing most favourable to the respective kinds, the success of the crop may, in a great measure, be commanded.

The varieties of the garden peas may, therefore, be

divided into early and late. The former are distinguished as being more slender in the plant, and less abundant in the crop, but they are more hardy, and can better withstand the cold weather; while some kinds admit better of being forced, and thus can be produced at the earliest approach of summer, as the grand vegetable luxury of the season. The late sorts are more vigorous, and more productive both in the number of the pods, and the size of the grain; and as they come to maturity by the natural heat of the season, and in a free change and circulation of the air, they are more rich and saccharine. Thus it happens, as is the case with many other articles of human food, that green peas are really of the best quality when they are so cheap that they may be purchased by the people generally.

The pea goes through all the stages of its vegetation in a very brief period. More than one instance is on record of a crop being obtained from seed matured the same season. Some Spanish dwarf peas were sown in February, and the crop was reaped the first week in July; some of the pods were left to mature their seed, which when sufficiently ripe were again committed to the earth on the same piece of ground, and a second crop was reaped on the 27th of September.*

To obtain the very earliest crops, the seeds are sown in a dry soil, about the end of October; in favourable situations and seasons they stand through the winter, and if the spring be a forward one they may be ready for gathering about the end of May. They are a precarious crop, however, and do not pay the cultivator, unless they are produced so early as to command a very high price. In consequence of the uncertainty of the winter, in places where the demand is such as to bear the expense, the earliest peas are brought forward in hot beds.

Of peas sown in the field there are several varieties. The dark sorts are generally the longest in coming to maturity, and they have the rankest flavour. In favour-

* Fleming's 'British Farmer's Magazine,' Nov. 1826

able places, if they are sown in autumn, and cleared the instant they are ripe, they may be followed by turnips the same year; but if the sowing is delayed till after Christmas, the ground will not be free in time for any crop save winter wheat. A crop of peas is considered to improve the soil, especially for turnips. But it is not on the whole very profitable, unless upon very rich loams, in which situation they are often sown with beans, and the produce used as food for stock. The bean-stalks, from their greater strength, prevent the peas from lodging.

The Bean (*Vicia faba*) has been cultivated in Britain from very remote antiquity, having been in all probability introduced into this country by the Romans. It is said to have originated in Egypt; perhaps because the Greeks, from whom we have the earliest accounts of it, received it from that country as a cultivated vegetable. Some travellers affirm that the bean is found growing wild in Persia, near the shores of the Caspian; but that part of Asia has been subjected to so many fluctuations, to so many alternations of culture and destruction, that it is not easy to decide whether any plants which may be discovered vegetating spontaneously be really indigenous, or only the remains of a former cultivation. In many parts of Britain, where all other memorials of former habitations and culture have been swept away, certain plants are found growing which a traveller passing hastily over the country would very naturally describe as indigenous, since of their introduction the present inhabitants of the vicinity could most probably give him no account, but which from history and the nature of the plants themselves are known to be exotics introduced at a specific time.

Beans are cultivated over many countries, as far to the eastward as China and Japan, and they are very generally used as an esculent in many parts of Africa: from its northern coast some of the more valuable varieties were transplanted by the Moors into Spain, and by the Portuguese into their own country.

This plant is grown abundantly in Barbary where

it is usually full-podded at the latter end of February, and continues in bearing during the whole of spring. When stewed with oil and garlic, beans form, according to Shaw, the principal food of persons of all classes.

The bean in its green state is well known as a culinary vegetable; when mature and dried it is never used as human food in this country, but is then considered good, though coarse nourishment for labouring horses. Campbell, in his 'Political Survey,' published 1774, mentions that "Beans are exported for the food of the negroes in our plantations, and are employed in feeding horses at home; so that altogether they are in daily use, and most certainly turn to a very considerable amount."* Provisions for this unhappy race of human beings are in the present day somewhat better selected, and horse-beans do not any longer form an article of export to the colonies.

All the cultivated beans are annuals, having upright fibrous stems rising from two to four feet high. The flowers are usually white, with a black spot in the middle of the wing; these are succeeded by long thick legumes, woolly within, and enclosing large flat seeds. These flowers are very fragrant, and the rich perfume of a bean-field, when the plants are in full blossom, is as familiar as it is delightful to all lovers of simple rural pleasures. The popular division of the several varieties is, like that of peas, into field beans and garden beans; the same variety is, however, often cultivated in both situations. The large variety called the "Windsor Bean" is said to have been first cultivated in that neighbourhood by some of the Dutch gardeners who came over at the Revolution. There is a field near Eton still called "the Dutchman's garden."

Beans are propagated by seed sown in rows from two

* King stated the annual consumption of beans at that period to be four millions, and of peas seven millions of bushels. Campbell, indeed, considered this estimate to be excessive, but if it at all approximates to the truth, it shows that these legumes were then cultivated to a very great extent.

to three feet asunder, either by the dibble or by drilling; the early kinds in October, and from December to January inclusive. The main crop is sown in March and April, and the several varieties are continued in monthly succession until July. For late crops the seeds, previously to being used, are soaked for several hours in soft water. Some cultivators cut off the tops of the plants when in bloom, which operation is supposed to promote an earlier and more abundant production of well-filled legumes; while a very late crop may be obtained by cutting down the plants, as soon as they are in flower, to within a few inches of the base. New stalks spring from the roots, and yield pods at an advanced period of the year.

The bean, though a coarser plant than the pea, is much more liable both to disease and to the depredations of insects. When the plants become sickly from an unfavourable soil or season, small fungi are apt to form withinside the epidermis, such as the nestling spheria (*Sphæria mdula*), upon the roots, and the bean-blight (*Uredi Fabæ*) upon the stems and leaves. Though these are most probably the consequence of a diseased state of the plants, they so destroy the epidermis as to render recovery impossible, and the crop is greatly injured or altogether destroyed. The black aphis also often commits terrible havoc; it generally appears first in the young leaves of the top, and therefore may be removed by a little timely care without injuring the plants, but if once it is allowed time to establish itself, it is very difficult of eradication.

The Kidney Bean (*Phaseolus*).—Two species are cultivated in England, both natives of warm countries, and though they grow and pod well in Britain during the warm months, they will neither bear the frosts of early spring, nor those of late autumn. The dwarf kidney-bean (*Phaseolus vulgaris*), a native of India, but erroneously called the French bean, is mentioned as being in common cultivation in England in the year 1597. The species called the *runner* (*Phaseolus multiflorus*) was introduced from South America in the year 1633. It is supposed that the scarlet variety, which

grows so tall and is so prolific, was first cultivated about that time by Tradescant, the celebrated gardener at Lambeth. It was then, we are told, in so great repute for its flowers, that they formed the leading ornament in the nosegays of the ladies; and it seems to have kept its place only as an ornamental plant for nearly a hundred years, as its legumes were seldom used as an edible substance until brought into notice by Miller of Chelsea in the eighteenth century.

The general characteristics of the two species are the same. The leaves are ternate, attached to long petioles; and the flowers, differing in colour according to the variety, grow on racemes or short lateral branches coming out from one common pedundle. These are succeeded by oblong pods containing smooth shining seeds of a kidney shape.

The stems are more or less voluble in all; but those of the dwarf kind are of very low growth, and require no support. The stalks of the runners ascend eight or ten feet, and, therefore, either tall sticks are provided around which they may wind, or they are planted near a building or fence from which slender cords are suspended, and the flexile stems as they rise clasp and entwine themselves with these. "It deserves notice, that in their voluble habit of growth the tendrils turn to the right or in a direction contrary to the apparent diurnal course of the sun: this aberration from the common habit of plants has been accounted for by supposing that the native climate of the scarlet runner will be found to lie south of the equator, and that the plant, although removed to the northern hemisphere, is still obedient to the course originally assigned to it, turning in a direction which in its native climate would be towards the sun." *

Both species are tender plants, and seldom thrive if they are sown very early in the season; but in favourable weather they are prolific bearers, especially the scarlet runner, which for a long continuance yields a plentiful crop from one sowing.

In England only the immature pod is used as a legume.

* Loud., 'Encyc. of Gardening,' p. 694

The ripe seeds known by the name of *haricots* are prepared in various ways as a favourite edible in France; where the dwarf white kidney-bean is extensively cultivated as a field crop, to furnish a supply of their seeds, which are in so constant demand. The seeds of the Dutch runners, which are larger than these, and of a superior quality, are made into a kind of soup, which is held in much esteem in Holland. The leaves likewise of the kidney-bean afford, when boiled, a culinary vegetable which the Nubians consider an excellent esculent.

Some varieties of the kidney-bean are found in cultivation throughout almost every civilized country of the western as well as the eastern hemisphere. The small black beans called *frixolles*, which are in general demand all over Mexico, are no doubt a kind of kidney-bean. Recent travellers in that country relate that immense fields of these are under cultivation for the supply of the large cities, where they form a part of every meal, and are not only in great favour with the inhabitants, but are considered excellent even by strangers.

Among the productions of Bornou, Major Denham enumerates four kinds of beans, which are raised in great quantities, called *mussaquà*, *marya*, *kleeny*, and *kimmay*, all known by the general name of *gajooly*. These are eaten by the slaves and the poorer people. A paste compounded from beans and fish was the only eatable the major and his companions could find in the towns near the river.*

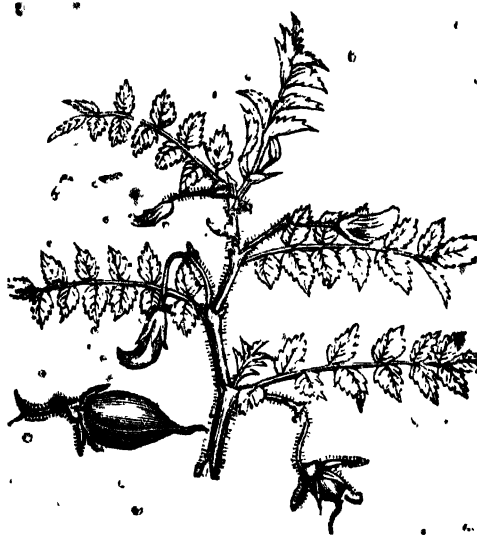
The Lentil (*Ervum Lens*) is a small climbing plant, with weak stalks, about a foot and a half high. The leaves are winged, and each is terminated by a tendril. The flowers, of a pale purple colour, are succeeded by short flat pods containing two or three flat round seeds. Another sort, distinguished as the French lentil, is of much larger growth than the former, and altogether more worthy of cultivation. These plants are rarely raised in England, and then only as food for cattle. In most parts of the Continent they are cultivated for the use of man, and the seeds are made into soups, or become

* Denham's 'Travels,' vol. ii. p. 143.

an ingredient in other culinary preparations. They are readily softened by, and mix with, water, forming with it a pottage of a chocolate colour. In Catholic countries, where the formulary of the church enjoins a number of *meagre* days, such plants as the kidney-bean and the lentil are more cultivated than they are in countries where the religion of the people does not prescribe the same observances. In England there are no fasts scattered through the year on which the people are expected to subsist upon pulse with the addition of vegetable oils. The use of haricots and lentils is therefore but little known in this country. According to the analysis of Dr. Playfair, the lentil contains more nitrogenous matter than any of the Leguminosæ, and consequently is more nutritious where digested than any of the other forms of leguminous seeds. The lentil is consumed in the East in considerable quantities, and a curious proof of its value as a nutritious diet is afforded by the use which is made of it amongst the Hindoos, who always have recourse to lentils in addition to their rice when engaged in laborious work, such as rowing on the Ganges, &c.

The CHICK PEA (*Cicer arietinum*) is another small legume which is occasionally cultivated in the south of Europe, especially in Spain, where it is used as a dyeing ingredient as well as an article of food. It is known there, and on the opposite coast of the Mediterranean, by the name of *garavance* or *garvanzos*. These seeds do not, like most other pulse, become of a soft and pulpy consistence by boiling, and therefore they never constitute a dish by themselves, but are strewed singly as a garnish over certain savoury viands, and form part of the *olla*, a dish composed of bacon, cabbage, pumpkin, and garvanzos, with which a Spanish dinner almost invariably commences. The chick-pea, when parched, has been much esteemed among many nations from the earliest periods of history, and in that state it still continues an article of great consumption. According to Belloníus,* this pea was the parched pulse which formed the common

* Calm., 'Dict. Bibl.,' lib. ii. cap. 53.



Chick Pea (*Cicer arietinum*).

provision of the Hebrews when they took the field; and Cassianus * supposes it to have been the torrified seed mentioned by Plautus and Aristophanes. The *frictum cicer* seems also to have constituted a part of the usual food of the lower orders at Rome.†

In those warm and arid countries where travellers are constrained to carry their scanty provisions with them across vast desert tracts, they gladly supply themselves with small dried substances which require much masti cation, and thus stimulate the salivary glands. Under

* Cassian., 'Collat.,' 8.

† Plautus, 'Bacch.,' act iv. 5, 7. Hor. 'Serm.,' lib. 2, Sat. 3, l. 182; De Arte Poet., l. 249.

these circumstances parched chick-peas, or *leblebby*, are in great demand, and are as common in the shops as biscuits in those of England. In Grand Cairo and Damascus there are many persons who make it their sole business to fry peas, for the supply of those who traverse the desert.

The seeds of the kerkedan, a small shrub found growing wild and sometimes cultivated in the south of Nubia, are made into a kind of bread, and form the principal food of the Kerrarish Arabs; and a decoction of the roasted grains is used as a substitute for coffee. Another shrub, called *symka*, indigenous to the same country, produces legumes resembling peas, and containing round rose-coloured seeds which afford excellent nourishment for camels, and are, when green, employed as human food. These likewise "the Arabs collect and dry, and by hard boiling obtain from them an oil which they use instead of butter to grease their hair and bodies."*

Various descriptions of pulse are cultivated in the East, but these are seldom of a large growth. The culture of smaller legumes as human food, similarly with that of the millets and other small-seeded grains, is adapted only to that state of society in which the money-price of labour is low, and yet where the climate and other concurring circumstances are obstacles to the cultivation of the more valuable kinds of vegetables. Moisture and heat, as well as a soil comparatively rich, are required for the production of rice; and the cerealia grown in more temperate climates cannot be raised unless there be either a sufficiency of manure, which cannot be procured without an abundant stock of domesticated animals, or a natural richness of soil, which is incompatible with dry land in a warm climate.

In the elevated parts of India which lie out of the direction of the periodical rains, a scanty irrigation can at best be obtained, and that only by sinking deep wells or by constructing tanks and reservoirs at a great expense; where these imperfect means are not within

* Burckhardt's 'Nubia,' p. 46.

reach, the ground is scarcely ever moistened, as probably a shower of rain does not fall during six months. Under these circumstances the cultivation of pulse is resorted to as a matter of necessity, and the smaller and the more hardy these are, the more certain is the prospect of their yielding a crop. In sultry climates there is often a portion of humidity which plays in the atmosphere, and which will form dew upon the leaves of a plant, when the evaporative power of the naked and baked earth is so great that not a condensed drop will settle upon it, or a trace of moisture be found. From this cause dew may be seen early in the morning spangling the verdant lawn when there is no humidity whatever upon the gravel walk; and upon a burnt-up heath, any plant which may have preserved its greenness, will attract moisture, when the withered grass continues perfectly dry. The pulses which are sown in the rainless parts of India not only preserve themselves, but often aid in preserving millet and other small grain with which they are mixed. When the Hindu, in his simple husbandry, sows several kinds of seeds on the same land, he does not therefore give a proof of his ignorance of the art. There is in it a little of the schooling of experience—the practical knowledge of the climate with which he has to deal. He sows his small grain in order that he may have a good crop if the season should send him rain; and he at the same time sows pulse in order that he may not only reap pulse in the event of a drought, but that he may even then perhaps obtain with it a little accompanying grain.

CHAPTER VIII.

BREAD-FRUIT.

Amongst many plants which might be mentioned as affording a sufficient quantity of nitrogenous matter to support life and enable man to maintain muscular exertion is the bread-fruit tree. It is referred to here, as at one time it was supposed to be an efficient substitute for bread, made from wheaten flour, and to partake of all its dietetical value. No analysis of this fruit, however, has been made to enable us to decide this point. It was originally found in the south-eastern parts of Asia and the islands of the Pacific, though now introduced into the tropical parts of the western continent and the West-India islands.

There are two species of it: the bread-fruit, properly so called (*Artocarpus incisa*), with the leaves deeply gashed or divided at the sides, which grows chiefly in the islands; and the Jack fruit, or Jaca tree (*Artocarpus integrifolia*), with the leaves entire, which grows chiefly on the mainland of Asia. The latter has been already noticed.

The bread-fruit is a beautiful as well as a useful tree: the trunk rises to the height of about forty feet, and, in a full grown tree, is from a foot to fifteen inches in diameter: the bark is ash-coloured, full of little chinks, and covered by small knobs; the inner bark is fibrous, and used in the manufacture of a sort of cloth; and the wood is smooth, soft, and of a yellow colour. The branches come out in a horizontal manner, the lowest ones about ten or twelve feet from the ground; and they become shorter and shorter as they are nearer the top: the leaves are divided into seven or nine lobes, about eighteen inches or two feet long, and are of a lively

Fruit of the *Artocarpus incisa*.

green. The tree bears male and female flowers, the males among the upper leaves, and the females at the extremities of the twigs. When full grown the fruit is about nine inches long, heart-shaped, of a greenish colour, and marked with hexagonal warts, formed into facets. The pulp is white, partly farinaceous and partly fibrous; but, when quite ripe, it becomes yellow and juicy. The whole tree, when in a green state, abounds with a viscid milky juice, of so tenacious a nature as to be drawn out in threads.

In the island of Otaheite and other places, where the bread-fruit forms the chief support of the people, there are, as is the case with cultivated vegetables in all countries, many varieties; only two, however, are very different from each other—that which contains seeds in the fruit, and that which contains none. The variety with seeds is much inferior to the other, being more fibrous, containing less farina, and not so pleasant to the taste; it is, therefore, not cultivated, though, in cases of need, it is roasted and eaten. Whether the seedless sort has been produced originally by cultivation it is not easy, and would not be of much importance, to ascertain: it is the

one cultivated in the South Sea islands; it was originally found only there; and the tree was not in much repute till these islands were discovered.

The bread-fruit continues productive for about eight months of the year: such is its abundance, that two or three trees will suffice for a man's yearly supply, a store being made into a sour paste, called *mahe* in the islands, which is eaten during the unproductive season. The planting of the seedless variety is now saved, as the creeping roots send up suckers which soon grow to trees. When the fruit is roasted till the outside is charred, the pulp has a consistency not very unlike that of wheaten bread; and the taste is intermediate between that of bread and roasted chesnuts. It is said to be very nourishing, and is prepared in various ways.

The timber of the bread-fruit, though soft, is found useful in the construction of houses and boats; the male flowers, dried, serve for tinder; the juice answers for bird-lime and glue; the leaves for packing and for towels; and the inner bark, beaten together, makes one species of the South Sea cloth.

The earliest account of the bread-fruit is by Captain Dampier, in 1688. "The bread-fruit," says this navigator, "grows on a large tree, as big and high as our largest apple-trees; it hath a spreading head, full of branches, and dark leaves. The fruit grows on the boughs like apples; it is as big as a penny loaf, when wheat is at five shillings the bushel; it is of a round shape, and hath a thick tough rind. When the fruit is ripe, it is yellow and soft, and the taste is sweet and pleasant. The natives of Guam use it for bread. They gather it when full grown, while it is green and hard; then they bake it in an oven which scorcheth the rind, and maketh it black; but they scrape off the outside black crust, and there remains a tender thin crust; and the inside is soft, tender, and white, like the crumb of a penny loaf. There is *neither seed nor stone* in the inside, but all of a pure substance, like bread. It must be eaten new, for, if it be kept above twenty-four hours, it grows harsh and choky, but it is very pleasant before it

is too stale. This fruit lasts in season *eight months* in the year, during which the natives eat no other sort of bread kind. I did never see of this fruit any where but here. The natives told us, that there is plenty of this fruit growing on the rest of the Ladrone Islands; and I did never hear of it anywhere else."

The scientific men who accompanied Captain Cook in his voyage came home with the most enthusiastic ideas of the bread-fruit. Dr. Solander calls it "the most useful vegetable in the world," and urges that no expense should be spared in its cultivation. The mere idea of bread, the most valuable food of man, growing spontaneously, was doubtless calculated to excite attention—almost, perhaps, as strongly as the subsequent description of the poet:—

"The bread-tree, which, without the ploughshare, yields
The unreap'd harvest of unfurrow'd fields,
And bakes its unadulterated loaves
Without a furnace in unpurchased groves,
And flings off famine from its fertile breast
A priceless market for the gathering guest."*

A tree, of the value and easy culture of which so very encouraging accounts were given, could not but attract the notice of the public generally, and more especially of those colonists of Great Britain who lived in a climate warm enough for its cultivation. An application to be furnished with plants of the bread-fruit tree was accordingly made by the planters and others interested in the West Indies, and it met with a favourable reception. The Bounty, a vessel of about two hundred and fifteen tons burthen, was fitted up for a voyage to Otaheite, Lieutenant (afterwards Admiral) Bligh, who had accompanied Cook on his last voyage, and shown himself an officer of great talents, enterprise, and bravery, was appointed to the command. In addition to the crew of the vessel, two men were appointed, at the recommendation of Sir Joseph Banks to take im-

* Byron.

mediate charge of the procuring, shipping, and tending of the plants.

The Bounty was skilfully fitted up for her intended purpose. A large cabin between decks, in midships, was prepared for the reception of the plants. This had two large skylights on the top for light; three scuttles on each side for ventilation of air, and a double bottom; an upper one of timber on which to place the pots and tubs containing the plants, which was drilled full of holes to allow escape to the superfluous water which might have injured them by stagnation—and a leaden one upon the lower deck, in which the water that ran through the other was collected, and from which it was conducted by a leaden pipe at each corner, into casks below for future use.

Thus prepared, the vessel put to sea about the middle of November, 1787, but was beat about and battled by contrary winds, so that the voyage was not commenced till the 23rd of December. The instructions given to Lieutenant Bligh were full and explicit. He was to resort to those places in the Society Isles where Captain Cook had stated that the bread-fruit tree was to be found in the greatest luxuriance, and there procure as many plants as the vessel could carry; after which he was to proceed with them to the West Indies with all possible expedition.

The commander sailed first for Teneriffe, and thence for the south of America, intending to enter the Pacific by the passage of Cape Horn. But the storms of that inhospitable region beat him back; and he was forced to bear away for the Cape of Good Hope, and reach the Society Islands on the side of New Holland. This voyage, which had occupied ten months, terminated on the 25th of October, by the arrival of the Bounty at Otaheite.

No time was lost in putting the instructions into execution. The young shoots that sprung from the lateral roots of the bread-fruit trees were taken up, with balls of earth, where the soil was moist; and this operation was continued till they were in possession of one thou-

sand and fifteen live plants, secured in seven hundred and seventy-four pots, thirty-nine tubs, and twenty-four boxes. To complete this cargo took them till the 3rd of April, 1789; and Bligh sailed on the 4th, passing from Otaheite through the group of islands, and bidding adieu to the natives, with whom he and his crew had been on the most friendly terms during their stay.

Hitherto there had been no perils to contend with but those of the sea; but when four-and-twenty days had elapsed, and they were, of course, far from any land, a new scene took place, which frustrated for a time the bounty of the government and the skill of the commander. Under the cloak of fidelity, a mutiny had been forming of a very determined and extensive nature; and so well had the mutineers disguised their intentions, that not one but those who were in the plot had the slightest suspicion of it.

The known bravery of Lieutenant Bligh made the mutineers afraid to attack him awake; and so, on the morning of the 28th of April, he was seized, while asleep in his bed, by a band of armed traitors, and hurried upon deck in his shirt; and, on coming there, he found the master, the gunner, one of the master's mates, and Nelson the botanist, who had been with him under Cook, confined in the fore hatchway, and guarded by sentinels. The launch was hoisted; and such individuals as the mutineers did not like were ordered to quit the ship, and forced if they refused or hesitated. Eighteen individuals out of the forty-six remained true to the commander; and one of them, Mr. Samuel, the clerk, contrived to save Mr. Bligh's commission and journals; but he failed in attempting to procure Bligh's surveys, drawings, and remarks during fifteen years, which were exceedingly valuable, and the time-keeper. Four of the men, who kept their allegiance, were detained by the mutineers contrary to their wishes. The cause of this singular mutiny, for which none of the usual motives could very well account, could not with certainty be known; but it was generally supposed that the instigator was Mr. Christian, one of the master's mates. Bligh

himself says, in his most interesting account of his voyage and mutiny, "It will naturally be asked what could be the cause of this revolt? In answer, I can only conjecture that the mutineers had flattered themselves with the hope of a happier life among the Otaheitans than they could possibly enjoy in England."

Thus, after they had made certain of the successful termination of an enterprise which was looked upon with a great deal of interest, both in a scientific and an economical point of view, Bligh was disappointed—and he and his faithful associates were sent adrift upon the wide ocean, in an open boat, with only an hundred and fifty pounds of bread, a few pieces of pork, a little wine and rum, a quadrant and compass, and a few other implements of navigation. But they were undaunted, and they were skilful; and though they had hard weather to contend with, they reached Tofoa, one of the Friendly Islands. But as the people there were treacherous, though not quite so successful in their treachery as their former shipmates, they again put to sea, and stood for New Holland, which they reached in safety; rested for a little, and got a supply of provisions. From New Holland they again sailed in the direction of the Eastern Archipelago; and, after suffering the greatest fatigue, being exposed to the full action and vicissitudes of the elements, and forced for some time to bear famine, they reached the Dutch settlement of Coupang, in the island of Timor, without the loss of one individual by disease; though they had traversed at least five thousand miles of sea. Nay, so ardent was Bligh as a seaman, that, amid all those perils, he was occupied in making some very valuable observations.

The Dutch governor of Coupang showed them every attention; and, from the care that was taken of them, twelve were enabled to return to England. Though the adventure had failed, everybody was disposed to bestow all praise on the adventurer; and he was promoted to the rank of captain, and appointed to the command of his Majesty's ship Providence, in order to repeat the voyage.

The Providence, with the Assistant, a small ship, in company, sailed on the 3rd of August, 1791. His instructions were to procure the bread-fruit trees for the West Indies, and, on his return, to examine the passage between the north of New Holland and New Guinea—which, in his former voyage in the Bounty, he had been the first to navigate.

On the 9th of April, 1792, they reached Otaheite; and, by the 17th of July, they were ready to leave the island, having on board twelve hundred and eighty-one tubs and pots of plants, all in the finest condition. There was no mutiny on this voyage; but the passage between New Holland and New Guinea was dangerous; and it was the 2nd of October before the captain reached his old friends at Coupang. He remained there for a week, replacing with plants from that island those that had died on the voyage; and then he came to the Atlantic by the Cape of Good Hope, which he contrived to pass so closely as never to have a lower temperature than sixty-one degrees of Fahrenheit.

On the 17th of September, he anchored at St. Helena, collected there a number of trees, and among others the akee; and, leaving twenty-three bread-fruits, and some other valuable plants, he sailed, and reached St. Vincent on the 23rd of January, 1793—where he left with Dr. Anderson, the superintendent of the Botanical Garden, three hundred and thirty-three bread-fruit trees, and two hundred and eleven fruit trees of other kinds, receiving at the same time nearly five hundred tropical plants for the Botanical Garden at Kew. From St. Vincent, Captain Bligh sailed for Jamaica, where he left three hundred and forty-seven bread-fruits, and two hundred and seventy-six others, which were a selection of all the finest fruits of the East. Some of the plants were also left on the island of Grand Cayman; and the ships finally came to the Downs on the 2nd of August, 1793.

But, after all the peril, hardship, and expense thus incurred the bread-fruit tree has not, hitherto at least, answered the expectations that were entertained. The banana is more easily and cheaply cultivated, comes into

bearing much sooner after being planted, bears more abundantly, and is better relished by the negroes. The mode of propagating the bread-fruit is not, indeed, difficult; for the planter has only to lay bare one of the roots, and mound it with a spade, and in a short space a shoot comes up, which is soon fit for removal.

Europeans are much fonder of the bread-fruit than negroes. They consider it as a sort of dainty, and use it either as bread or in puddings. When roasted in the oven, the taste of it resembles that of a potato, but it is not so mealy as a good one.

CHAPTER IX

CARBONACEOUS SECRETIONS—STARCH—THE POTATO.

THE plants mentioned in the preceding chapters all of them yield in the food which they supply one or other of the carbonaceous secretions. The flour of wheat contains starch, barley contains sugar, and the fruit of maize oil; but these plants are more indebted for their use amongst mankind to the nitrogenous matters they contain than to any other secretion. The plants now to be mentioned yield only or chiefly the carbonaceous secretions. There, it will be recollected, are starch, sugar, and oil.

Of the plants yielding starch, none are more important than the potato; but its importance at the present day is not so much given to it by the starch it contains as by the small quantity of nitrogenous matter which is found in it. In estimating the potato as an article of diet, its composition should always be taken into consideration; and this will point out the fact, that although potatoes have been used as a substantive article of diet by man, they stand very low in their nutritionary power, and that starch is their distinguishing alimentary secretion. Although eaten by the poorer classes for the sake of its fibrine, it is never employed thus in a state of society which it is desirable to maintain. The potato is consequently placed here amongst plants yielding carbonaceous secretions, lest the ordinary impression that it is a food comparable to the European cerealia should be countenanced.

The composition of the tuber of the potato is as follows:—

Water	72
Starch	26
Fibrine . . .	2
	100

With the exception of turnips, it contains less fibrine than any of the substances ordinarily used as food by man. This will account for the fact, that persons who subsist entirely on potatoes are obliged to eat very large quantities, in order to obtain from them a due supply of nutriment. Drs. Lindley and Playfair found that, upon the average, an adult Irish peasant ate not less than fourteen pounds of potatoes every day. It thus becomes a question as to whether this tuber is the economical food it has been so often represented. Whether, however, it be a desirable article, as a principal diet or not, there can be no question of its advantage as an adjunct to a food containing the flesh of animals.

The common and very general culture of the potato in this kingdom at the present day renders it difficult of belief, that so comparatively short a period should have elapsed since its introduction, and that the time when this vegetable was served up in small quantities as a rarity should be in the present recollection of aged persons.

There is strong evidence for believing that this plant was first introduced into England by the colonists adventuring to North America under the auspices of Sir Walter Raleigh, who had obtained a patent in 1584 from Queen Elizabeth "for discovering and planting new countries not possessed by Christians." Thomas Heriot, afterwards known as a mathematician, was among these voluntary exiles; who, however, all returned within two years after they had first gone forth for the purpose of founding a colony. These voyagers most probably brought home the potato, since in Heriot's report of the country, which is printed in De Bry's collection of voyages, he describes (vol. i. p. 17), under the article Roots, a plant called *openawk*, which there is little doubt is identical with the potato. "The roots of this plant," says he, "are round, some as large as a walnut, others much larger; they grow in damp soils, many hanging together as if fixed on ropes. They are good food either boiled or roasted." The introduction of this plant into Ireland by Sir Walter Raleigh, on his

return from Virginia, is indeed well authenticated by corroborative testimony. In the manuscript minutes of the Royal Society, we find that Sir R. Southwell distinctly stated to the fellows, that his grandfather was the first who cultivated the potato in Ireland, and that for this valuable root he was indebted to Sir Walter Raleigh. Among the anecdotes told of this enterprising voyager, it is said that when his gardener at Youghal, in the county of Cork, had reared to the full maturity of "apples" the potatoes which he had received from the knight, as a fine fruit from America, the man brought to his master one of the apples, and asked if *that* were the fine fruit Sir Walter, having examined it, was, or feigned to be, so dissatisfied, that he ordered the "weed" to be rooted out. The gardener obeyed, and in rooting out the weeds found a bushel of potatoes.

In contradiction to the above account, Dr. Campbell, in his 'Political Survey,' states that this plant was not introduced into Ireland until the year 1610; while some writers affirm that the people of that country were in possession of the potato at a period prior to the one just assigned. One supposition is, that this root was brought from Santa Fe into Ireland in the year 1565: and another, that it is of so very ancient a date in that island as to make it equally probable that it is a native vegetable of the country. It is found, however, that the plant carried to Ireland by Captain Hawkins, in 1565, was the Spanish batata, or sweet potato. The claim to its greater antiquity in that country was made by Sir Lucius O'Brien, who stated to Mr. Arthur Young that the venerable Bede mentioned this plant as being in Ireland about the year 700. Sir Lucius did not, however, point out the passage containing any proof of his assertion; and the potato, largely as it is cultivated in that country, has not yet made out its title to a place in the indigenous flora of Ireland.

Gerarde mentions in his 'Herbal,' published 1597, that he cultivated this plant in his garden, where it succeeded as well as in its native country. He gives a drawing, which he distinguishes by the name of Vir-

ginian potato, having, as he states, received the roots from Virginia, otherwise called Nozembega. It was, however, considered by him as a rarity, for he recommends that the root should be eaten as a delicate dish, and not as common food.

From the authority of more than one writer, it would appear that the potato was brought into southern Europe through a different channel, and at an earlier period than the introduction of the root from Virginia into this country. Clusius relates that he obtained this root at Vienna in 1598, from the governor of Mons in Hainault, who had procured it in the preceding year from Italy, where, in common with the truffle, it had received the name of *taratouffli*. Peter Cieca, in his 'Chronicle,' printed in 1563, chap. xl. p. 49, relates that the inhabitants of Quito and its vicinity, besides producing maize, cultivated a tuberous root which was used as food under the name of *papas:* this, it is affirmed, is the same plant which had been transplanted to the south of Europe, and which Clusius received from Hainault.

Humboldt rather doubts if sufficient proof can be produced of this root having been indigenous to South America. Upon the interesting subject of the native country of the potato, we gladly quote the following account by Mr. Cruickshanks:*

"Mr. Lambert, in the tenth volume of 'Brande's Journal,' and in the appendix to his splendid work on the genus *Pinus*, has collected many valuable facts which prove that the potato is found wild in several parts of America, and among others in Chili and Peru. Don José Pavon, in a letter to Mr. Lambert, says, 'The *Solanum tuberosum* grows wild in the environs of Lima, and fourteen leagues from Lima on the coast; and I myself have found it in the kingdom of Chili:' and Mr. Lambert adds, 'I have lately received from Mr. Pavon very fine wild specimens of *Solanum tuberosum*, collected by himself in Peru.' There is also a note from

* Originally published in Dr. Hooker's 'Botanical Miscellany,' and quoted in the 'Journal of the Royal Institution' for December, 1831.

Mr. Lambert on the same subject, in the third volume of the 'New Edin. Phil. Journ.,' with an extract from a letter of Mr. Caldcleugh, who sent tubers of the wild plant some years ago from Chili to the Horticultural Society. But it is frequently objected, that in some of those countries where the *potato* is found wild, it may, like many other species met with in that state in America, be an *introduced*, not an *indigenous* plant. There are, however, many reasons for believing that it is really indigenous in Chili, and that wild specimens found there have not been accidentally propagated from any cultivated variety. In that country it is generally found in steep, rocky places, where it could never have been cultivated, and where its accidental introduction is almost impossible. 'It is very common about Valparaiso, and I have noticed it along the coast for fifteen leagues to the northward of that port, how much farther it may extend north or south, I know not. It chiefly inhabits the cliffs and hills near the sea, and I do not recollect to have seen it at more than two or three leagues from the coast. But there is one peculiarity in the wild plant that I have never seen noticed in print, that its flowers are always *pure white*, free from the purple tint so common in the cultivated varieties; and this, I think, is a strong evidence of its native origin. Another proof may be drawn from the fact, that while it is often met with in mountainous places, remote from cultivated ground, it is not seen in the immediate neighbourhood of the fields and gardens where it is planted, *unless a stream of water run through the ground, which may carry tubers to uncultivated spots.* 'Having observed the distribution of this and other plants through the agency of the streams employed for irrigating the land, I am led to think that the wild specimens found near Lima may have had similar origin. If they occurred in the valley, this is more than probable, as almost the whole of the land is either cultivated by irrigation, or the uncultivated spots are overflowed when the river is swelled by the rains in the interior. Upon the whole, it may be safely concluded that this important vegetable is really indigenous to

Chili; but with respect to Peru, some further evidence appears necessary to remove all doubt on the subject. The question can only be decided by ascertaining the exact situations in which the plants present themselves at Lima and Chancay, especially with respect to land that is or has been cultivated. It would be interesting, too, to know the colour of the flowers."

Though now so extensively used, the value of this root as an esculent was not perfectly appreciated for a great length of time in this country, during which period it was indeed only cultivated in gardens, and that as a curious exotic. The potato was considered as a great delicacy in the reign of James the First. At that period, though it formed one of the articles provided for the household of the queen, the quantity used was extremely small and exorbitantly dear, being at the price of two shillings per pound.* This esculent remained equally scarce throughout the turbulent times of the succeeding reign, and during the Commonwealth. Its cultivation very gradually spread in different parts of Ireland, and also into Lancashire, but not till nearly a hundred years after the discovery of Virginia by Raleigh. Mr. Buckland, of Somersetshire, in the year 1663, drew the attention of the Royal Society to its value, earnestly recommending the general cultivation of the potato throughout the kingdom to guard against a famine. This appeal was not made in vain. A committee was appointed to inquire into its merits, and all those Fellows of the Society who had lands adapted for the growth of the potato were entreated to plant them with that vegetable. while Mr. Evelyn was requested to notice the subject at the close of his 'Sylva.' This celebrated man appears, however, not to have been aware of the importance of the potato as an article of food, for he did not mention it until more than thirty years after that period, and then in rather slighting terms. In his 'Kalendarium Plantarum,' the first gardener's calendar published in Britain, he thus writes:—"Plant potatoes in your worst

* Eden on the 'State of the Poor.'

ground. Take them up in November for winter spending, there will enough remain for a stock, though ever so exactly gathered." In another of his works, 'Aceturius,' he remarks that the small green fruit or apples of the potato make an excellent salad. This assertion has not, however, been verified by experience.

The zeal of the Royal Society to promote the growth of this vegetable failed for a long time to exercise much influence upon the habits of the nation; and, if we may judge from the opinions which were published respecting the plant, we must conclude that the necessities of the poor of Ireland, who have ever been left too entirely to their own resources, did more to promote the culture of potatoes than all the labours of the learned, and the philanthropy of the patriotic. At the end of the seventeenth century one writer on gardening, indeed, admits that "potatoes are much used in Ireland and America as bread, and may be propagated with advantage to poor people." Woolridge, who wrote in 1687, twenty-four years after the appeal of Mr. Buckland, describes potatoes as being very useful in "forcing fruits," stating that they are planted in several places in this country to good advantage; he adds, "I do not hear that it has been yet essayed whether they may not be propagated in great quantities for the use of swine and other cattle." The celebrated Ray, who began to publish his 'Historia Plantarum' in 1686, takes no further notice of this vegetable than by saying that it is dressed in the same manner as Spanish batatas. Merrett, who wrote in the following year, records that potatoes were then cultivated in many fields in Wales, but in what part of the principality he does not mention.

On the other hand, Lisle, who made observations on husbandry from the year 1694 to 1722, is wholly silent about the potato. In Mortimer's 'Gardener's Kalendar' for 1708, this plant is directed to be sown in February, and, as if its character had not been generally known, it is added – that "the root is very near the nature of the Jerusalem artichoke, although not so good and wholesome, but that it may prove good for swine." In the

'Complete Gardener,' by the eminent nurserymen Loudon and Wise, the seventh edition of which was published in 1719, no mention is made of this root; and Bradley, who wrote about the same time, and whose very extensive works on horticultural subjects treated expressly on new improvements in the art, notices it as if by compulsion. "They (potatoes) are," says he, "of less note than horse-radish, radish, scorzonera, beets, and skirret; but as they are not without their admirers, I will not pass them by in silence." * *

These facts and extracts are curious, as they serve to show that this most valuable article of food was not brought into general use by the skill and labour of professional men, but in defiance of their prejudices and the bad methods of culture which they promulgated. There can indeed be little doubt that the imperfect modes of both cultivating and preparing the potato as an esculent were in a great measure the causes which prevented its more speedy adoption as a wholesome and substantive article of food; while this very ignorance of its nature and management produced the low estimation in which it was held by writers about the beginning of the eighteenth century.

To those who know anything practically of the cultivation of this plant, it must be evident how much the early sowing, the late taking up, and the leaving in the ground during winter of the roots intended for propagation, tended to deteriorate the quality of the potatoes. These circumstances, together with the little culinary skill exercised in its preparation, caused it to appear under no very tempting form. A person who had been invited to taste the first potatoes which were planted in the county of Forfar, in or about the year 1730, related that the roots had been merely heated, and that they adhered to the teeth like glue, while their flavour was far from agreeable. The food was about to be condemned through the ignorance of the cook, when the accidental arrival of a gentleman who had tasted a potato in Lancashire, caused the rejected roots to be remanded

back to the hot turf-ashes, till they became as dainty as they had before been nauseous.

We have no records of the early practice and progress of potato-husbandry in Ireland. The more tardy progress and the less favourable results attendant on this culture in England, might induce a belief that it had been better conducted in the former country; though no doubt the more genial climate of Ireland, its humidity, and the absence of those chilling winds from the east, which are so often fatal to the tender spring crops of England, gave to it a natural advantage, and might perhaps sufficiently account for the superiority of this branch of husbandry in Ireland over England.

The early practice in this country of planting potatoes in February was, in itself, an effectual bar to their goodness as field culture, since the young plants betray their origin to have been from a warmer climate, by their inability to bear the slightest degree of frost with impunity; so that if they put forth their tender heads to the nipping frosts of spring, a great part of the crop is certain to fall a sacrifice. The better quality of the potato grown in Ireland, and its excellence as a substantive article of food among a population sunk to the lowest state of poverty, caused it to be brought into general use in that country, finding its way even to the tables of the rich, at a period when it was scarcely known in the sister island.

The introduction of this plant into Scotland was probably earlier than into any part of England, with the exception, perhaps, of Lancashire. The people living in that county were then distinguished by a marked difference of habits, manners, and character from their neighbours. A remnant of these peculiarities is even still to be found, notwithstanding the singularities of the inhabitants and local circumstances combined to render this a favourable situation for the introduction and improvement of the potato.

The land in Lancashire is rather poor, and the climate rainy, so that wheat, with even the present improved

system of husbandry, cannot be raised to very great advantage. Oats were consequently there, as in Ireland and the Lowlands of Scotland, the staple production. The mechanics, who worked chiefly in iron and brass, were all cottagers, who followed their respective employments in the winter, and raised food for themselves upon their little patches of land in the summer. The population of Lancashire then bore a great resemblance to the cotters of Ireland. They were, however, more ingenious in handicraft works, and still more resembled the manufacturing peasantry in the centre and south of Scotland, who grow the whole or the greater part of their food upon their cottage lands. Even the education of their children was formerly often obtained out of the produce of their little field; the schoolmaster went "thigging," that is, collecting a portion of produce from every cottager, in proportion to the wealth of the individual, and to the number of pupils he might have contributed to the school-room. The poor likewise were relieved by a voluntary contribution of produce, and it is probable that this system worked as well as that of a compulsory rate. Even in the smaller burghs of Scotland, and in the villages where the lands are held on *feu* or perpetual lease, the same system was, and in many places still is, followed. The portioners, as they are called, are allowed a house in the village, and land for their subsistence, in the surrounding fields.

In such a state of the peasantry the cultivation of the potato would offer peculiar advantages, as no other substantive article of food could be raised by the inexperienced rustic in equal quantities, with so little risk and trouble, and without any but his own and his family's labour being required for its culture and after-preparation. Accordingly, when once this plant was introduced into cottage cultivation in Scotland, its importance was quickly recognised.

It is understood, however, that this valuable root was not, until the year 1728, made the object of useful culture among the Scotch, and they were then indebted to a cottager for first attempting its culture. This

man's name was Thomas Prentice; he was a day-labourer living near Kilsyth, in Stirlingshire, and drawing his subsistence partly from the produce of his little plot of ground. This crop proved extremely valuable, and was almost instantly in demand for propagating other crops, first among the cottagers, and then among the farmers. Prentice continued to cultivate this root very carefully, and to supply his neighbours with the produce of his crop. He was, moreover, frugal and industrious, so that in a few years he found himself in possession of two hundred pounds, no small fortune at that time and in that place. When he had "made his fortune," he sank his capital in an annuity, at a good interest, upon which he lived independently to an old age. The last years of his life were spent in Edinburgh, where he died in the year 1792, at the advanced age of eighty-six, having thus been, for sixty-four years, a witness to the happy effects of the blessing which he had been instrumental in conferring on his country.

But notwithstanding the success that attended the culture of the potato among the cottagers, its progress among the higher classes in Scotland was retarded by the opinions of the writers formerly alluded to; while, what is not a little singular, a mistaken zeal in religious matters made some of the Scotch folks hostile to the innovation. "Potatoes," said they, "are not mentioned in the Bible," and thus the same anathema was pronounced against them as against the "spinning-wheel" and the "corn farmers."

The name of this plant was indeed inserted in the 'Hortus Medicus Edinburgensis,' published by Sutherland in 1683. It is therefore probable that the potato had been introduced as a curiosity into some of the gardens about Edinburgh some time before it was brought into full culture by Prentice. But if its management was the same as that recommended by so great an authority as Evelyn, the produce was most probably of little value.

The year 1742, which was long remembered in Scotland as "the dear year," gave an impulse to the cultiva-

tion of the potato. Old people who were still living at the beginning of the present century represented the state of things in the summer of 1743 as being dreadful. Many of the destitute wandered in the fields seeking to prolong the misery of existence by devouring the leaves of peas and beans, of sorrel and other wild plants; while not a few perished from absolute want, and still more were carried off by those diseases which always follow and aggravate the devastations of famine. This state of distress naturally called the general attention to the cultivation of the potato, and indeed to the whole agriculture of the country. So that, during the latter half of the eighteenth century, the practice and science of husbandry made much more rapid progress in Scotland than in England. Previously to this general scarcity in 1743, some potatoes which were growing in the county of Roxburgh were so uncommon as to have been considered objects of curiosity. But the state of things soon altered, and immediately after "the dear year" the farmers of Lothian began to make this a branch of field husbandry.

In England, with the exception of Lancashire, the progress of the cultivation of the potato continued at an extremely slow pace. It was known in Yorkshire only as garden produce down to 1760; and in Somersetshire it was rare indeed to meet with a whole acre under this culture so late as 1770.

So little attention had been bestowed on this subject even by the most intelligent landowners, that Miller, in the quarto edition of his 'Gardener's Dictionary,' published in 1771, names only two varieties, and founds the distinction of these not upon quality, or time of coming to maturity, but on the trifling accident of a red and of a white colour, which is found to be productive of no other difference. At present, however, the varieties are so numerous, without any reference to colour, that it would be equally vain to attempt their description within any limited compass, as it is unnecessary to point out their uses or enumerate their properties.

Not many years after the appearance of Miller's valuable work, the potato began to form an important article

of English husbandry; and in the year 1796 it was found that in the county of Essex alone seventeen hundred acres were planted with this root for the supply of the London market.*

The culture of the potato is now so extensive in this country, that an abundant supply can be obtained in all places throughout the year; and such have been the improvements in the culture, and the varieties to which these improvements have led, that a succession is furnished fresh out of the earth for nearly six months in the year. The early sorts have been the reward of horticultural skill now so successfully exerted in this country; under the shelter of frames, with careful management, the tender young plants are made to struggle through ungenial weather, and to produce tubers at the earliest approach of summer.

The culture of the potato in the rest of Europe appears to have attained to no great extent until during the last century. In the latter half of this period it was made in more than one country a subject of interest and inquiry. Several works published about that time, treating on its culture, are to be found in the French and German languages. From one of these† we learn that the potato was introduced from England into the Netherlands; and was thence transplanted into some parts of Germany. It was first cultivated in Sweden in 1720, but, notwithstanding the exertions and recommendations of Linnæus, it did not come into general cultivation until 1764, when a royal edict was published for the encouragement of this branch of husbandry.

The potato was still unknown to the agriculturists of Saxony so late as 1740; but so rapidly did its culture increase, that less than thirty years after the above date, a small detachment of the French army, while in that country, having its supplies wholly cut off, the soldiers subsisted for eight or ten days entirely on potatoes ob-

* Loudon's 'Encyc. of Gardening.'

† 'Traité de la Nature de la Culture et de l'Utilité des Pommes de Terre, par Un Ami des Hommes,' 1771.

turned from the fields; nor was this manner of living considered among them as by any means a hardship.

The Swiss discovered the value of this cultivation about the same period in which it was introduced into Sweden, and in a few years they not only grew potatoes among their mountains in abundance, but had likewise learnt the art of drying them, grinding them into flour, and making them into bread. A traveller in 1730 relates that the miller of Untersen had scarcely anything to grind but potatoes; and in 1734 a peasant was so well aware of the profit arising from this culture, that he bought a small field situated near the Swiss mountains, and in only two years after paid the purchase-money by the produce of his potato crops.*

It is said by another writer,† about the same period (1770), that during the twenty-five or thirty years preceding, the culture of this root in some parts of Switzerland had so much increased, that it constituted the food of two-thirds of the people. In the present day it still forms a principal article of food among the peasantry of that country.

It likewise makes a very prominent figure in the husbandry of Poland, where it is cultivated to an extraordinary extent. In 1827 as much as 4,288,185 korzecs‡ of potatoes were produced in that country, while 4,439,399 korzecs of rye were reaped, 3,183,023 of oats, 4,506,062 of barley, and 751,076 of wheat.§

The cultivation of the potato has been of late years introduced into some parts of India with every prospect of success. In Bengal, especially, it has been attended with the most satisfactory results. Bishop Heber, in his interesting Journal, notices in several places the progress of this culture, the crops becoming by degrees more and more extended. These roots were at first very unpopular, but they have gradually gained favour, and are now spoken of as being the best gift which the

* 'Traité de la Nature,' &c.

† 'Dictionnaire de Bomare,' Art. Pommes de Terre.

‡ One korzec is nearly equal to two hundredweight.

§ 'Foreign Quarterly Review,' No. xiv. p. 531.

natives ever received from their European masters. They are, we are told, held in much esteem, "particularly by the Mussulmans, who find them very useful as absorbents in their greasy messes."* The following observations are gathered from the same volumes. In the neighbourhood of Patna many descriptions of European vegetables are brought to market in abundance; they are, however, reared for the consumption of the European inhabitants alone, the natives rejecting all but the potato, which, though known only since the last few years, may perhaps soon take its rank with rice and plantains, as a substantive article of food with the frugal Hindu. It is already largely cultivated in that district, but can never become an exclusive crop, inasmuch as those humid stiff soils which are peculiarly favourable to the growth of rice are wholly unsuited to the potato, the cultivation of which must therefore be confined to those sandy and drier soils which are inimical to the culture of the rice plant. In such situations this vegetable of English production may be raised with unmixed utility, while the result of so important a supplementary crop may, in seasons of the failure of the rice harvest, avert the evils of famine, and diminish, in one strong point of view, the resemblance between the Indian and Irish peasantry—their reliance on a single article of food. The almost infinite division and subdivision of their farms is in India, as in Ireland, a fertile source of poverty and wretchedness.

The observations of another intelligent writer† on the same subject likewise tend to show the advantages which may result from this cultivation in Hindustan. He remarks that a dry season is prejudicial to the rice crop, while it is favourable, or rather not so hurtful, to that of the potato, and "therefore nature points out the one crop as a substitute when the other fails." It is certainly a fortunate circumstance that the superstition by which the Hindu is enslaved does not shut up every

* Heber's 'Journey,' vol. i. p. 13.
† Tennant, 'Indian Researches.'

avenue to innovation and improvement. No religious prejudice forbids the culture of this vegetable, and therefore the natives evince a readiness to adopt it in all situations where it can be as easily obtained as other food.* The soil of Bengal, and the long continuance of dry weather, may, perhaps, be obstacles sufficient to prevent this root from becoming the principal nourishment of the lower orders; but it is supposed that if it could be raised cheaper than rice, the potato would be generally preferred by Hindus. At present it is almost universally served up at European tables in Bengal in the same manner as in England; and though the crop is less abundant, and the roots are smaller in size, they are scarcely inferior in quality to those of this country.

Wherever the Englishman seeks a home, he always strives to naturalize this root, which was so long struggling into notice in his own country. Now, amid all the luxuriant and delicious vegetation of tropical climes, he still retains his preference for that simple vegetable, which he considers almost a necessary of life. At Ceylon all his attempts to cultivate this plant have been nearly vain, as it will not thrive in that island at any place except at Candy, a town almost seventy miles in the interior, and the only spot in the country where European vegetables come to any degree of perfection. A basket of these roots is sent every morning thence for the supply of the governor's table, as all the indigenous vegetables are considered an inferior substitute for this necessary auxiliary to the Englishman's more substantial fare.†

* The Southern Africans in this respect prove themselves more obstinately adverse to innovation than the Hindu. "The Matchappees, though very fond of potatoes, have never been prevailed upon to plant any, because they resemble nothing which has been handed down to them from their forefathers, to whose manners and customs they seem as strongly attached as the Hindu or the Mussulman."—Campbell's 'Travels in South Africa,' vol. i. p. 101.

† Heber's 'Journey,' vol. iii.

It would be superfluous to give any but a slight description of a plant so well known, as annually forming new subterranean tubers, and rising with weak, slender, and branching stems, from two to three feet in height. The leaves are composed of leaflets of unequal size, the flowers are white or of a purple tinge, producing large berries, which are green at first, but which change nearly to black when at maturity, and contain numerous small white seeds. The supposed root, but which is really an underground stem, consists of many tubers connected to the base of the stems by cords or fibres, and having minute branchy rootlets which issue from different parts of each tuber, and which serve to convey nourishment to the plant. The several points whence these are produced are usually called the eyes of the potato, and each of them contains the germ of a future plant.

The uplands and the lighter soils are found to be much better adapted than rich and strong lands to the cultivation of the potato. This root has one great advantage over all grain and leguminous crops, in being perfectly secure against the late rains, which often completely destroy the hopes of the farmer. Rains which have no bad effects upon the potato, injure the bloom upon the cerealia, or cause them and the legumes to run so much to straw as not only to be less productive of seed, but actually to lodge and rot. The quality of the roots is no doubt a little deteriorated by excess of moisture, but when they are sufficiently matured rain has little or no injurious influence over them.

This plant seems alone to have been wanted to make the agriculture of the British Isles complete. Upon the western side, and among the mountains, a grain crop is always precarious, and seldom or never good. Scanty and bad as it is, its culture is also expensive, as, after it has been reaped, it cannot be left in the field to dry, but must be taken wet into barns constructed of wicker-work for the purpose of obtaining a current of air, and there suspended upon ropes. Such a process is not merely

tedious and costly, but absolutely incompatible with the culture of any considerable quantity of grain.

A new soil produces better potatoes than worked land in the highest condition; and ground which is light and spongy, provided that it has the advantage of plenty of moisture, which does not stagnate, is better than the strongest lands. The reasons are obvious—the tubers will form with the greater ease according as the resistance is less which the ground offers to their expansion, while so large a quantity of vegetable matter elaborated in so brief a space demands no little supply of humidity. Now the little patches among mountains are composed of the very best soil for this purpose, being generally a mixture of sand and vegetable matter. Such a soil is readily penetrated throughout by every shower, and yet the water does not stagnate; as a mountainous country near the sea is, in high latitudes, always one in which there are frequent showers, the watering of these mountain patches is precisely that which is most beneficial, and therefore it would be difficult to imagine a soil and climate better fitted for the growth or for producing excellence in the quality of these tuberous roots.

When cultivated in tenacious argillaceous soils, if the summer be dry, the swelling of the tubers is prevented by the mechanical pressure of the earth; and on the other hand, such soils, if kept constantly in a state of moisture, produce immature tubers, which are sodden, waxy, and otherwise of bad quality. But in ground which to all appearance is little else than loose sand, if there be humidity enough, potatoes will grow and be of excellent quality, and, even should there be any failure in the sufficiency of moisture, the quality of roots yielded by the first planting will be good, but they will be small, and too hard for propagating. In the mountain districts of Scotland the frequent rains in all seasons are of so constant recurrence, that a whole week of dry weather is considered worthy of record. This circumstance, so unfavourable to the maturity of other crops, operating in union with the peculiar nature of the soil, causes the situation to be well adapted to this cultivation:

while there are still other advantages on the west coast of the Scottish Highlands, and which apply in a great measure to Ireland. In the first place, there is very little frost—never any except in high and comparatively inland places—until the potatoes are come to their proper growth. Again, spade husbandry is best adapted for potatoes, and it is also the best for those places where the acclivities are generally too abrupt, and the spots of land really worth culture too small to admit of the use of the plough with any advantage. Persons who are acquainted with only flat countries, where there is little inequality of soil in a field, and no absolute sterility in a parish, but that which is consequent on neglect, can form but an imperfect idea of the variations witnessed in a little portion of mountain land. In a section of thirty yards there may be ten yards of useless gravel in which moisture can find no resting-place till it be fathoms deep in the ground, ten where there is not above three inches of soil on the bare rock, and ten of soil of the very best quality. The first and second portions would not of course produce a crop of any description, and yet in the use of the plough it would be necessary to pass over them, or to lose about the same time in turning; so that the expense of ploughing such a piece of land would be triple that of ploughing the same extent of a champaign country. On the other hand, when the spade is employed, the culture of the fertile spots is not more expensive than if they were continuous, and situated on the flattest surface in the island; while the nature of the soil renders the labour of turning it and taking up the crop comparatively easy.

Thus the potato has this great and peculiar advantage over all other substantive esculent vegetables, that it can not only be cultivated in places where no others can be profitably grown, but that it can be cultivated there at small expense; while it is less subject to disease and more secure against degenerating in those situations than on richer lands. Consequently, in a soil so diversified as that of Britain, and where the communication between any two places is so easy, an almost

unlimited supply of potatoes may be grown without any diminution of the breadth of profitable crop of the cerealia, the legumes, or indeed of any other useful plant; while this crop is recommended as causing an amelioration rather than an exhaustion of the soil.

The most usual and profitable manner of propagating this vegetable is by putting into the ground the tubers, either whole or divided into as many parts or *sets* as they contain eyes. The quality of soil best adapted for this culture has already been sufficiently indicated. The sets are planted in lines from twenty to twenty-four inches apart, either in drills or by the dibble, at intervals of from twelve to fifteen inches. The proper season for planting the main crop is from the middle to the end of March, and a peck of seed potatoes is usually required to plant a bed of twelve feet by thirty-two. In field culture eighteen bushels are planted in one acre. The young plants are kept free from weeds, and when they are about half a foot or a foot high, some earth is drawn around the lower part of the stem; little or no further care is required till the taking up of the crop. The plants are suffered to remain until the roots attain to their full growth. This state is indicated by the stalks beginning to decay, which usually takes place at the commencement or latter end of October, when the roots should be dug up for the winter store. Some careful cultivators pinch off the blossoms as they appear on the plant: the good effects of this practice have been very often proved, it being supposed that the weight of the tubers of each plant is increased an ounce in consequence, or considerably above a ton per acre.* The cause of this result has been thus explained:—the fluid or sap gives sustenance alike to the tuber and blossom, and therefore, if a portion be diverted from the formation of the blossom, it will be exerted for the enlargement of the root.

This plant may be propagated also from cuttings or layers of the green shoots, and from seeds. The first is

* 'Hort. Trans.' vol. i.

not at all advantageous for any culture, except in some instances, when it is required to multiply as quickly as possible a rare sort.

The tubers obtained from seeds are at first very few and very small, and therefore seed cultivation is by no means advisable to "the grower" of potatoes; but it is of great service to "the breeder," who seeks to improve its quality. No vegetable is more yielding to the hand of the cultivator than this plant. Raising it from seed enables him to obtain varieties without end, and attention to the qualities of those between which the crossings take place, admits of obtaining any particular quality that may be wanted.

On the other hand, by cultivation from the tubers a good variety may be extended and preserved after it has been once obtained; as the plant from the tuber is not a new plant, like that which is procured by the operations of flowering and seeding, but an identical part of the old one. Though the planting tubers will not lead to any new variety, it may have effects every way as advantageous; for no plant profits more by changes from one district to another.

Besides improvement in quality which a judicious change produces, it likewise often prevents a disease to which the potato is liable. This disease is known by the technical name of the *curl* or the *curl-top*, a name by no means inexpressive of the appearance of the plant when under its influence. The top leaves begin to shrink just about the time that the tubers should form, the young shoots cease to expand, and the whole plant assumes very much the appearance of the tip of a cherry twig, when the under leaves are assailed by aphides. From the moment in which this disease appears, all further growth in the plant ceases, and though it may linger in a yellow and sickly state until autumn, the produce, if any, is little, and that little is of a bad quality. If, as soon as the disease shows itself, the tuber which has been planted be taken up, it will be found much firmer and less exhausted than those of the plants of the same age that are in a healthy state. This at the same time

points out the cause of the disease and suggests its remedy. The old tuber has been too compact for yielding to the vegetative powers of the plant.

The curl first made its appearance in this country in the year 1764, in Lancashire, where potatoes had been first introduced into British field culture, and had been propagated without any change of seed. From Lancashire this disease spread over all the potato districts of Britain, and as the cause and cure were equally unknown, there was a general apprehension that the plant would be exterminated. Premiums were offered by different agricultural societies to those who should point out a remedy for a disease so destructive; in consequence of which many speculations and theories were raised, which, however, led to very little practical utility.

The discovery of at least a temporary preventive, and therefore of the probable cause, was made, as is believed, more from accident than design, in the neighbourhood of Edinburgh. Some of the growers in that situation were in the habit of procuring seed potatoes from the cold moorland districts, and fields planted with these were free from the curl. Upon inquiry it was found that in those bleak and humid situations the potato crop was so late that the frost came on and blackened the leaves, while they and the stems were still green, and the tubers of course not ripe. The change of climate was therefore not the sole cause of prevention, if indeed it was the cause at all, for when the full ripened potatoes were planted in the moors, the curl appeared in them, in situations where there was none in the native potatoes.

It was thus found that the curl could be prevented by using tubers that were not quite ripe.

A writer in the 'Gardener's Magazine' for May, 1827, thus ingeniously accounts for this fact:—"The potato tuber is a perfect organized system, in which the circulation regularly proceeds, and if suffered to ripen will then tend to decay; but if separated before ripe from the stem or stalk which furnishes it with blood or fruit

sap, descending from the leaves, the circulation of the blood-sap is suddenly arrested. The ripe potato, having performed all its operations, becomes more inert; but the circulation of the sap in the unripe tuber having been stopped, it starts more readily, and with greater vigour, when planted: the one appears to die, worn out with age; the other seems accidentally to have fallen asleep, and when awakened, possesses an unspent vigour and energy."—p. 317.

That over-ripeness is the principal cause of the disease, has been found by experience to be so much the case, that out of the same potato it is possible to make some sets that will, and others that will not, produce the curl. The portion of the tuber that is nearest to the cord by which it is fastened to the plant, ripens first, as any one may observe, especially in an elongated potato, where the root end is often so mealy as to fall to powder, when the top or thick end is soft and waxy. If such a potato be taken when only the small end is ripe enough to boil mealy, the eyes upon another of the same parcel that are upon the waxy part will all produce sound plants, while curl may appear in those which are taken from the mealy end. The soil and mode of culture may have likewise some effect in producing this evil. Experience has shown that high culture and stimulating manure tend more to produce curl than poorer treatment, —that this disease is less frequent in new lands than in those which have been long under culture,—and that it seldom appears in cold and upland places.

The potato is subject to another disease, which, although it has been observed for some years past on the continent of Europe and in the United States, did not excite much attention till the year 1845, when Great Britain became alarmed by the appearance of this disease in the potato crops of Ireland. One of the earliest writers on the diseases of potatoes is Von Martius, who, in a work* published at Munich in 1842, described several diseases which had been observed in the potato

* 'Die Kartoffeln-Epidemie.

in various parts of Germany, and one closely resembling that which appeared in Great Britain in 1845. For several years, more especially during 1842, 1843, and 1844, a disease of the potato was observed in the United States of America; and during the latter year it was so prevalent as to induce the American government to appoint a commission to inquire into the nature, causes, extent, and remedies of this disease. Although little attention had been paid to any failure in particular crops of potatoes in England, yet the writer of this possesses satisfactory evidence that potatoes were affected with the disease which prevailed in 1845, during the year 1844.

One of the earliest public notices of this extraordinary distemper appeared in the 'Gardener's Chronicle' of the 16th of August, 1845, from Dr. Bell Salter, of Ryde, in the Isle of Wight. He thus describes its character: "The first appearance is a dark spot on the margin of the leaf, which withers the leaf and spreads rapidly to the stem. The discoloration soon extends along the stem in the course of the vessels, and the whole plant rapidly becomes black, so that within three days after a plant is attacked it has become totally destroyed. With this appearance in the upper part there co-exists a fatal change in the tubers; they become likewise spotted, at first near the eyes on the upper surface; the cuticle separates; the substance becomes friable, and the change soon spreads throughout the whole potato." Such was the first account of the disease. It was soon found that it had appeared in various parts of England at the same time, and what was worse than all, that it had made its appearance in Ireland. Such was the alarm felt on this subject, that the Government thought it necessary to appoint a commission, consisting of Professors Kane, Lindley, and Playfair, to investigate the nature and extent of the disease, and the amount of probable failure in the crops from its effects, in Ireland. Such an inquiry was not necessary in England, but in Ireland, where upwards of four millions live chiefly on potatoes, it became a matter of the utmost importance to ascertain

the real condition of the crops. The commissioners from Ireland presented a report that has led the Prime Minister, Sir Robert Peel, to adopt measures for a more free supply of food to this country. Not only did the disease prevail in Great Britain during the year 1845, but almost throughout the whole continent of Europe, pointing to a common cause for its origin.

In most instances the disease is easily detected, from the dry and shrivelled external appearance of the tuber, but in many cases it cannot be discovered till the potato is cut into with a knife, when one or more black spots may be seen in the very centre of the tuber. On placing the diseased tissue of the potato under the microscope, the cells are found to contain a brown amorphous matter, which give the colour to the diseased tissue. Granules of starch are also seen in the cells which appear to have been unaffected by the disease. In addition to this, crystals of oxalate of lime are frequently observed present in the interior of the cells.

On submitting the diseased potato to chemical analysis it is found that the quantity of water in the tissues has increased. Dr. Playfair made several analyses, and found that it contained 80 per cent. of water. He also found that sound potatoes contained in the same year (1845) a larger quantity of water than usual.* The consequence of this would of course be a diminution in the amount of starch. The fibrine does not appear to undergo any change in quantity, but Professor Liebig observed a curious change in the quality of the nitrogenous constituent, having observed that it was converted into vegetable casein (cheese). This substance has a much greater tendency to enter into decomposition than fibrine, and in this way Liebig accounts for the production of the disease. It is worthy of observation that none of the constituents of the affected tubers, seem to have undergone any injurious change, so that however disagreeable they might be to the taste, they did not act as a poison on the system. A French experimenter, M.

* Scottish Guardian, Nov. 1845

Boyican, put this to the test, and lived for several days on the diseased potatoes, and drank the water in which they were boiled, and yet suffered no other inconvenience than would have occurred from having recourse to a diet of healthy potatoes.

Under the microscope the granules of starch appear to have suffered no change; and when separated, they are as available for all the purposes of diet as those procured from healthy potatoes. The starch is easily separated from the potato by scraping it on a grater and throwing the softened pulp into water, when the cellular and fibrous matter will fall to the bottom of the water insoluble, and the starch will be held in suspension in the supernatant fluid. The liquid, on being decanted off and set aside, will deposit the starch, which may be re-washed, and may then be used for all the purposes of arrow-root, sago, or tapioca.

The cause of this disorder has been the occasion of difference amongst those who have written on the subject. During the progress of the disease, and especially during the latter stages in the tissues of the tuber, several species of the lower order of fungi have been observed to be present; and from a knowledge of the fact that the spores of some of these fungi are capable of engendering other forms of disease in plants, it has been concluded that they are the cause of the disease in this instance. Of those who defend this theory of the origin of the potato murrain, there is no one whose opinion is entitled to more respect than that of the Rev. M. J. Berkeley, author of a volume on the fungi of Smith's 'English Botany.' In a paper in the first volume of the 'Journal of the Horticultural Society' he says, "The decay is the consequence of the presence of the mould, and not the mould of the decay. It is not the habit of the allied species to prey on decayed or decaying matter, but to produce decay, a fact which is of the first importance. Though so many other species have this habit, these have not. The plant then becomes unhealthy in consequence of the presence of the mould, which feeds upon its juices and prevents the elaboration

of nutritive sap in the leaves, while it obstructs the admission of air and the emission of perspiration. The stem is thus overcharged with moisture and eventually rots, while every source of nutriment is cut off from the half-ripe tubers." On the other hand, Professor Lindley, Dr. Playfair, Mr. E. Solly, and others, attribute the disease to atmospheric causes alone. Dr. Lindley, in the 'Gardeners Chronicle' of August 23, 1845, says: "The cause of this calamity is, we think, clearly traceable to the season. During all the first weeks of August the temperature has been cold, from two to three degrees below the average; we have had incessant rain and no sunshine. It is hardly possible to conceive that such a continuation of circumstances should have produced any other result, all things considered. The potato absorbs a very large quantity of water; its whole constitution is framed with a view to its doing so; and its broad succulent leaves are provided in order to enable it to part with this water. But a low temperature is unfavourable to the motion of the fluids, or to the action of the cells of the plant; and, moreover, sunlight is required in order to enable the water sent into the leaves to be perspired. In feeble light the amount of perspiration from a plant is comparatively small: in bright sunshine it is copious; in fact, the amount of perspiration is in exact proportion to the quantity of light that falls upon a leaf. At night or in darkness there is no appreciable action of this kind. During the present season all this important class of functions has been deranged. The potatoes have been compelled to absorb an unusual quantity of water; the lowness of temperature has prevented their digesting it; and the absence of sunlight has rendered it impossible for them to get rid of it by perspiration. Under these circumstances it necessarily stagnated in their interior, and the inevitable result of that was rot."

According to Dr. Playfair, in his lectures delivered before the Royal Agricultural Society of Great Britain, in Dec., 1845, this rot consists in a simple union of the tissues of the tuber with the oxygen of the atmosphere,

a tendency to such a union being given by the imperfect manner in which the cellular tissue of the plant is developed. It is not perhaps a matter of importance which part of the plant is attacked first; but Dr. Lindley says, that "although we first see the symptoms of the disease in the leaves, and then in the haulm, yet we believe that it commences underground, in that part of the haulm which is just above the old set."

During the prevalence of the disease it was found that sound potatoes were capable of contracting the same state from unsound ones, and this points to the necessity of keeping the potatoes, when dug up, as far from each other as possible. They should be placed in some dry material, as sand, turf, dry mould, &c., and be kept in a cool place, as a high temperature favours decomposition. In the next place they should be well ventilated, as the same air remaining constantly in contact with the potato serves to increase the disease.

In planting potatoes for seed it seems desirable to avoid using those which have been in any manner diseased, and those should be chosen which have grown on lands where none of the potato crop has suffered. It is however to be hoped that it will be long before such a concurrence of untoward events takes place as produced the potato murrain of 1845. Should the visitation of this disease lead to the more general cultivation of the better kinds of food in the sister country, it may still have to be regarded as a great blessing, although its immediate effects are of so painful a nature.

In concluding this notice of the potato, we would call attention to the following table given by Dr. Lyon Playfair at the lectures above alluded to, to illustrate the relative value and cost of the potato as an article of food. In all food the most important constituent for the working man is the nitrogenous matter called protein :—

lbs.			Cost. s.	d.
25	of milk contain 1 lb. of protein	.	3	1
100	of turnips ,, ,,	.	2	9
50	potatoes ,, ,,	.	2	1

lbs.			Cost. s.	d.
50	carrots contain 1 lb. of protein		2	1
4	flesh	,, ,,	2	2
9	oatmeal	,, ,,	1	1
7½	barley-meal	,, ,,	1	2
7½	bread	,, ,,	1	2
7½	flour	,, ,,	1	2
3½	peas	,, ,,	0	7
3½	beans	,, ,,	0	6½

The most obvious preventive of actual famine in Ireland from the effects of the potato disease is the importation of MAIZE. This course has not been neglected by the Government as a temporary measure; it is recommended to the legislature that it should be rendered always available by the importation of maize free of duty. We have given a short account of this valuable plant in a preceding chapter of this volume.

Since the above was in type, the forced crops of potatoes are making their appearance. From a large amount of evidence collected in the 'Gardener's Chronicle' of March 7, there can be no doubt that the disease has again made its appearance, and that the crop for 1846 cannot be relied on. *Under these circumstances, it is hazardous to plant potatoes, and we recommend in the most decided manner that* OATS, PARSNIPS, *and* CARROTS *be planted in their stead.*

CHAPTER X.

STARCH (*continued*)—CASSAVA—ARROW-ROOT, SAGO, ETC.

THE CASSAVA (*Jatropha Manihot*) is known also as the edible-rooted physic-nut, and in Brazil it bears the name of *Mandioc*. It springs from a tough, branched, woody root, the slender collateral fibres of which swell into those farinaceous masses for which alone the plant is cultivated.

The height to which the cassava attains varies from four to six feet; it rises by a slender, woody, knotted stalk, furnished with alternate palmated leaves, which are smooth, and increase in breadth till within an inch and a half from the top, when they diminish to an acute point. The middle lobes are six inches long, and two inches broad in the broadest part; the two next are an inch shorter, and the outer lobes are only three inches long.

South America is held to be the native region of this plant, which formerly afforded the greatest part of their sustenance to the entire Indian population of that vast region. In the Mexican States cassava is more used on the western than on the eastern coast.

When the climate is favourable, the plant is of a hardy nature and of easy culture. It however requires the land to be of good quality, and the same spot cannot well be employed to yield two crops of it in succession. It needs a dry situation for its most successful cultivation, and when spots of a different nature are applied to the purpose, precautions must be taken, by raising hillocks whereon to set the cuttings, against the effects of excessive moisture, which would rot the plants: some mois-

Cassava (*Jatropha Manihot*).

ture is, notwithstanding this, needed by the plant at its earliest stages.

There are nine different species of Jatropha enumerated by botanists, only two of which are cultivated for human food. These two are—

The *Jatropha Manihot*, or bitter cassava; and

The *Jatropha Janipha*, or sweet cassava.

The first of these varieties, when in its natural state, is highly poisonous; while the other, although equally agreeable and wholly innocuous, is yet not cultivated to anything like an equal extent. The two roots are very similar in appearance, their only perceptible difference being a tough, ligneous fibre or cord running through the heart of the sweet cassava root, which the bitter variety is wholly without. Bread is made of both kinds, which is palatable and wholesome; and although its

taste may be thought somewhat harsh by persons accustomed to soft fermented bread made from wheaten flour, cassava bread is not without its admirers, and is in such high repute with those who have been accustomed to its use, as to be frequently procured at some expense and trouble by Creole families who have transferred their residence to Europe.

The tubers are spindle-shaped, much resembling parsnips in appearance: they are generally about fourteen or fifteen inches long, and four or five inches thick at the middle. When first dug out of the ground they are washed clean; the rind, which is of a dark colour, is then peeled off, and the root is ground or grated. In Brazil, where the preparation of mandioc is carried on to a larger extent than in any other place, many persons are employed together in peeling the roots, which are then applied to and pressed against the face of a wheel, which is made to revolve with great velocity, and in this manner they are ground, a trough being placed beneath the wheel to receive the pulp. The next process is that of expressing the poisonous juice, which is effected by placing the pulp in bags, and subjecting it to the action of a press. The only further operation required to fit it for consumption is that of baking, which is then performed on a hot iron hearth. The pulp being placed on this, forms itself into a very thin cake, similar in form to a pancake, and fifteen inches or more in diameter. During the period occupied in this baking, the cake is kept constantly in motion to prevent its being partially burnt, and as soon as it is crisp is removed from the fire: when sufficiently cool, it is then quite fit for use. If kept in a dry situation, these cakes will remain good for a very long period.

To whatever cause the poisonous quality of the juice of bitter cassava may be owing, it is so highly volatile as to be entirely dissipated by exposure to heat. Even a comparatively low temperature suffices for correcting its deleterious nature; for when the root has been cut into small pieces and exposed during some hours to the direct rays of the sun, cattle may be fed on it with perfect safety.

If the recently extracted juice be drunk by cattle or poultry, these will speedily become much swollen and die in convulsions; but if this same liquid is boiled with meat and seasoned, it forms a favourite soup, called by the Brazilians *casserepo*, and which is found to be wholesome and nutritious. Dr. Pinckard mentions having partaken of this soup in Demerara.*

Stedman acquaints us that the Indians of Guiana, among whom cassava forms the chief bread, first grind the root on a rough stone, and then, for the purpose of separating the juice, prepare a curious kind of press out of reeds, which being disposed in the form of a long tube and secured at bottom, the ground pulp is introduced, and the press being suspended to a tree, a heavy stone or log of wood is fixed to the bottom, the weight of which draws the tube gradually together, by which means the juice is squeezed through the interstices. Occasionally the juice is collected into a receptacle, and is then used for the poisoning of arrows. The baking process of these inhabitants of the woods is similar to that described above, with this only difference, that, being without iron plates, their cooking is performed upon heated stones.†

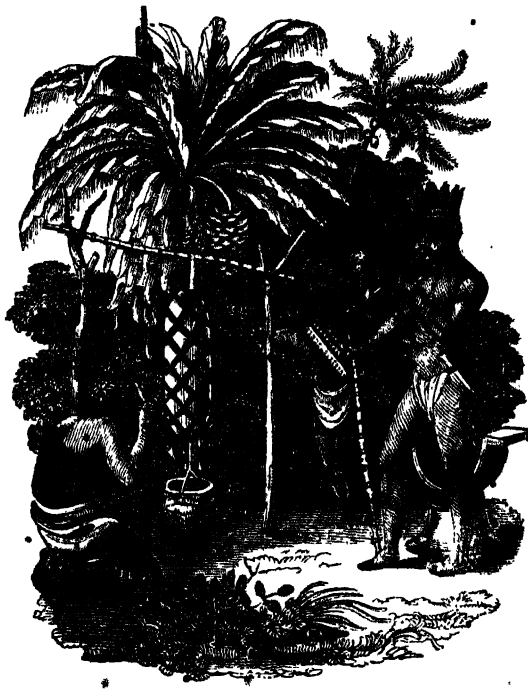
The roots of sweet cassava are eaten by the Indians after roasting them in hot ashes, and without submitting them to the previous processes of grinding and expressing the juice.

Both plants are propagated by cuttings, which very quickly take root, and in about eight months from the time of their being planted the tubers will generally be in a fit state to be collected; they may, however, be left in the ground for many months longer without sustaining any injury.

The juice of mandioc is sometimes fermented with the addition of molasses, and converted into an intoxicating liquor in great favour with the Indians and negroes. The former of these possessed a knowledge of the means

* 'Notes on the West Indies,' vol. ii. p. 257.

† 'Narrative of an Expedition to Surinam,' vol. i. p. 405.



Indians preparing Cassava.

of preparing inebriating fluids when first they were visited by Europeans, who in this instance are therefore free from the reproach which in too many cases attaches to them of introducing the practice of drunkenness among those whom they were bound to have enlightened by communicating knowledge, rather than to have brutalized by imparting vices.

Tapioca, which is capable of being made into excel-

lent puddings, and which is a very wholesome food for children, and for persons whose digestive powers are feeble, is a kind of starch prepared from the farina of cassava roots. A considerable quantity of this preparation is exported annually from Brazil to Europe.

A new species of Phaseolus was accidentally discovered some time since in the island of St. Domingo. A gentleman who was collecting plants in that island for the king of France, taking shelter in a cave, observed near it, upon some trees, a climbing plant, bearing clusters of dry pods. These seeds he gathered and sowed. The plants grew quickly and luxuriantly, and produced many roots, closely resembling that of cassava, and these, upon being treated in the manner already described, yielded very good cassava bread. In consequence of this discovery, the plant, which was found growing commonly in the woods of St. Domingo, was for some time after used in this manner; no part of the plant, with the exception of the tuberous root, was found to be edible.

Salep (*Orchis mascula*). This plant is assiduously cultivated in the East, for the sake of its root, which forms a considerable part of the diet of the inhabitants of Turkey, Syria, and Persia. Botanists have enumerated many species of this genus of plants, which are fleshy-rooted, and from several of which salep may be prepared. That which is generally preferred, however, is the one above named, the *Orchis mascula*, or male orchis, and it is from the root of this that the starchy substance brought from the Levant is supposed to be prepared.

This article of commerce comes to us in pieces of an oval form, very hard, approaching to transparency, and of a yellowish white colour. Although this substance has been for so long a time imported from a distant market, the plant from which it is prepared is furnished spontaneously, and in great abundance, in many parts of our own country. The Turkey roots are, however, much finer than ours, which may account for the greater esteem in which they are held.

The plant consists of a root composed of two fleshy lobes, crowned with oblong, broad, spotted leaves, and

Salep (*Orchis mascula*).

having upright stalks growing to the height of twelve inches, furnished with one or two narrow leaves, and terminated by a long spike of reddish purple flowers, which exhale a very slight agreeable odour; these commonly appear in the months of May, June, and July. The soil best adapted to its growth is that which is dry and not very fertile. It is worthy of remark that in rich lands, and those which have been highly manured, the Orchideæ do not come to maturity; where the experiment has been tried, the roots of the few plants that did appear proved black, and were half rotted in the ground. The stem is sent up by the lobe of a former year, and the new lobe, which is therefore easily distinguishable from the old one, is formed in the course of the summer as the tubers of potatoes. The root is known to be fully ma-

tured when the leaves and stalk begin to decay; the plants may then be dug up, and the new lobes—from which alone salep is made—separated from the others.

Many methods have been proposed for preparing salep. In the performance of the one among those methods which appears to be the simplest and best, the new root is first washed in warm water, when the fine brown skin with which it is covered may easily be rubbed away by means of a coarse cloth or a brush. The roots being thus cleaned and peeled, are to be arranged on a tin plate, and then placed within an oven heated to the same degree as is necessary for the baking of bread; here they are to remain from seven to ten minutes, in which time they will exchange their opaque and milky whiteness for a semi-transparent horn-like appearance, and a yellowish colour, retaining their original bulk. Being then withdrawn from the oven, they are exposed during some days to dry and harden in the air; or by the employment of a very gentle heat they may be brought to the same state in the course of a few hours: all that is then required to adapt the salep for food, is to boil it in water to the required consistency.

It is said that salep contains a greater quantity of nutriment in the same bulk than any other vegetable body; and for this reason it has been proposed that it should be made to form a part of the provisions of every ship that undertakes a distant voyage. So high a nutritive power has been assigned to salep, that, it is asserted, if one ounce of the powdered root, mixed with an equal weight of the stiff animal jelly or glue known as portable soup, be boiled in two quarts of water, it will suffice for the daily nourishment of an able-bodied man. This, however, is a mistake, as it consists principally of starch, which is not a nutritious aliment.

A small quantity of salep added to milk has been found to retard the commencement of the acetous fermentation in that fluid; and there is reason to believe that if it were used in a moderate proportion, it would prove a very useful and economical addition to wheaten flour in the preparation of bread. Dr. Percival, in his

'Medical and Experimental Essays,' mentions the results of some experiments of this kind. "I directed," says he, "one ounce of the powder to be dissolved in a quart of water, and the mucilage to be mixed with a sufficient quantity of flour, salt, and yeast. The flour amounted to two pounds, the yeast to two ounces, and the salt to eighty grains. The loaf, when baked, was remarkably well fermented, and weighed three pounds two ounces. Half a pound of flour and an ounce of salep were mixed together, and the water added according to the usual method of preparing bread. The loaf, when baked, weighed thirteen ounces and a half, but it should be remarked that the quantity of flour used in this trial was not sufficient to conceal the peculiar taste of the salep."

It is to be presumed that the last-mentioned circumstance did not occur where the proportion of wheat flour was greater, and the result is certainly such as should at least encourage the prosecution of further experiments. This vegetable preparation is held to be exceedingly wholesome, and was formerly in considerable favour with medical practitioners.

INDIAN ARROW-ROOT (*Maranta arundinacea*). Arrow-root, when prepared for use, bears a considerable resemblance to the substance last described, consisting, equally with that, of little else than starch. It forms, therefore, a pleasant and useful aliment for children and invalids.

The plant from which it is prepared is a native of South America. It is an herbaceous perennial, and is propagated by parting the roots. It rises to the height of two or three feet, has broad pointed leaves, and is crowned by a spike of small white flowers. It is much cultivated both for domestic use and for exportation in our West India islands, and in some parts of Hindustan.

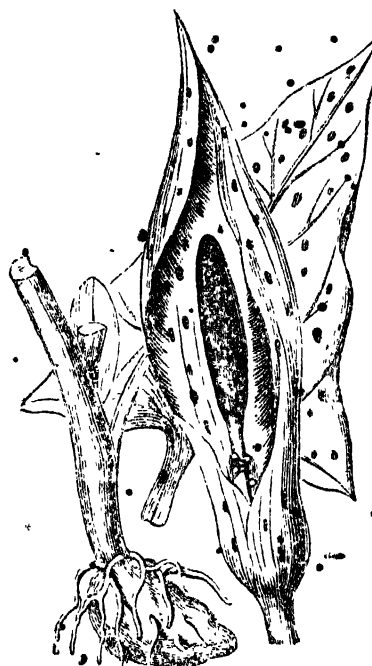
There are several species of Maranta, as the *M. arundinacea*, or starch plant, the *M. ramosissima* of India, the *M. Indica*, &c., which are thus cultivated. The name by which it is commonly known it owes to the use which was formerly made of another plant which was once con-

Indian Arrow-root (*Maranta arundinacea*).

founded with it, but is now distinguished by the name of *Alpinia Galanga*. The Indians employed that root for extracting the virus communicated by their poisoned arrows.

The starchy matter, for the obtaining of which the plant is cultivated, is prepared by the following process: When the roots are a year old they are dug up, and having first been well washed in clear water, are either grated or beaten to a pulp in large wooden mortars. This pulpy substance is next thrown into a large proportion of clean water, and after the whole has been agitated for some time the fibrous parts are collected in the hand,

squeezed, and rejected. The milky liquor which remains is a mixture of the starch with water, and this, after being strained through a hair sieve to separate such fibrous particles as have escaped before, is left for some time to settle, when the water is drained off. The white pasty mass remaining at the bottom is then again washed in a further portion of water, and allowed to subside as



Wake-Robin (*Arum maculatum*)

before; and this process is sometimes repeated a third time, and oftener even, by persons who wish to be exceedingly nice in preparing the powder. When this is considered to be sufficiently cleansed, it is dried on clean white cloths in the sun, and is then fit for consumption: it will keep for a very considerable length of time.

Other plants have been proposed as substitutes for the exotic above described. Among these the *Arum maculatum*, or common wake-robin, has been mentioned. This plant grows wild in woods and on shady banks in many parts of Great Britain.

In its natural state the *Arum maculatum* is exceedingly acrid, so that if a small piece of the leaf be chewed it produces a painful stinging sensation in the mouth, and by applying the juice of the raw tuber to the skin, this will be considerably blistered. The noxious quality here mentioned is, however, like that inherent in the cassava root, extremely volatile; and if the root be either roasted or boiled, and afterwards dried and pounded, it affords a starchy substance which is perfectly insipid, and may be used for the same purposes as the powder of the true arrow-root.

Many roots, some the peculiar growth of America, as well as the potato and mandioc, yield substantive food to the inhabitants of both the northern and southern divisions; they contain principally starch, but enough nitrogenous matter to serve the purposes of the system. Among these the SPANISH or SWEET POTATO (*Convolvulus Batatas*) is commonly cultivated for its root in the tropical climates, both of the eastern and western hemispheres. It was known in this country before the common potato, which, as we have before observed, received its name from the similarity which it bears to the batata.

This plant was introduced into England by Sir Francis Drake and Sir John Hawkins, in the middle of the fifteenth century. Attempts were made to naturalize it in this country, but it was found too tender to thrive in the open air through an English winter. Gerarde cultivated it in his garden in 1597, where it flourished

Sweet Potato (*Convolvulus Batatas*).

during the warm season; but as soon as it was assailed by the cold weather, it drooped, and perished in the ground. The roots were at that time imported into England in considerable quantities from Spain and the Canaries; and were used as a confection rather than as a nourishing vegetable. A more abundant supply of fruit of home growth has caused the batata gradually to decline in favour, and for many years it has ceased to be an article of importation into this country.

This plant is an herbaceous perennial, which sends out many trailing stalks, extending six or eight feet every way; these are round, and of a pale green colour; at each joint roots are put forth, which, in a genial climate, grow to be very large tubers, so that from a single plant forty or fifty large roots are produced. The leaves

are angular, and stand on long petioles. The flowers are purple. Several varieties of this plant are to be found in the different countries where it is cultivated, and which differ from each other in size, shape, and the flavour of the roots. The batata is propagated by laying down the young shoots in the spring; indeed, in its native climate it multiplies itself almost spontaneously; for if the branches of roots that have been pulled up are suffered to remain on the ground and a shower of rain falls soon after they have been broken off, their vegetation will recommence. The roots are sweet, nourishing, and though rather insipid, of no unpleasant flavour. In warm climates the batata is of very abundant growth, and easy of propagation; and therefore it is matter of surprise that, in Brazil, the mandioc should be cultivated in preference as food for the negroes, the batata being raised more as a luxury for the planter's table.

In the national garden at Paris this plant is raised in a hotbed, whence it is transplanted at the latter end of the spring into the open ground, and treated like the common potato. In favourable seasons a tolerable crop is produced; and hopes are entertained that in the course of some years the batata will be so far acclimatized as to be the object of successful field-culture in the south of France.

The YAM (*Dioscorea sativa*) is a native of the East; and is supposed to have been transplanted thence to the West Indies, as it has never been found growing wild in any part of America, while in the island of Ceylon and on the coast of Malabar it flourishes in the woods with spontaneous and luxuriant growth. It is very extensively cultivated in Africa, Asia, and America, for its root, which is nutritious and of good flavour, and is used either roasted or boiled as a substitute for bread. This root is farinaceous, and resembles the potato, but is of a closer texture.

Some yams were first brought into this country from the West Indies in 1733; and they are now occasionally imported, more, however, as an article of curiosity than of commerce.

Yam (*Dioscorea sativa*).

The yam is a climbing plant, with tender stalks of from eighteen to twenty feet in length; it has smooth, sharp-pointed leaves, on long footstalks, from the base of which arise spikes of small flowers. The root is flat, and palmated about a foot in breadth, white within, and externally of a dark-brown colour, almost approaching to black.

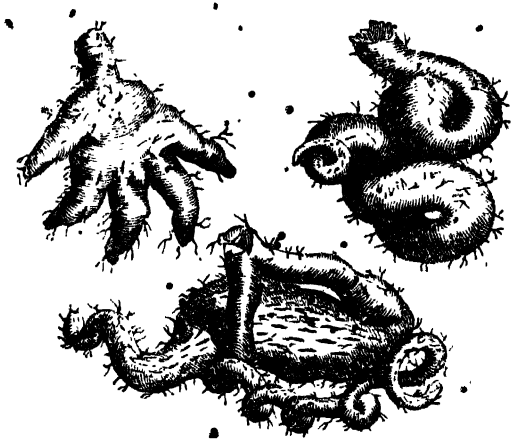
The winged yam (*Dioscorea alata*) is another species very generally cultivated; its roots attain to a larger size, being frequently about three feet long, and weighing about thirty pounds. Both these kinds are cultivated like the common potato. They are usually planted in August, and are fit for use in the November and De-

cember following. Brown* directs that the roots for planting should be cut so as to leave a small portion of skin to each piece; "for by that alone," he affirms, "they germinate, the roots having no apparent buds or eyes, but casting out their weakly stems from every part of the surface alike."

When dug out of the earth, the roots are placed in the sun to dry, and are then put into sand or casks, where, if guarded from moisture, they may be preserved a considerable length of time without being in any way injured in their quality.

ARRACACHA (*Arracacia esculenta*), an umbelliferous plant, is cultivated in some parts of South America for its root, which is farinaceous, and easy of digestion. The main roots branch into four or five parts, which attain to the size of cows' horns. Sanguine hopes were entertained by English horticulturists that this root might in the course of time become nearly as important to Europe as the potato, and that it may, like that, be acclimatized in England. It grows on the plains of Bogota, on an elevation of 8700 feet above the level of the sea. The temperature of these lofty plains is found not greatly to vary from that of the south-west of England. The mean temperature of Santa Fe de Bogota is fifty-eight degrees; the mean temperature of the warmest month sixty-two degrees; of the coldest month fifty-seven degrees. If any spot in the south of England or Ireland can be found of a similar temperature, it is probable that the arracacha will survive throughout the year in the open air. The mean temperature of Plymouth is about fifty-three degrees; mean of hottest month sixty-three degrees; mean of coldest month forty-two degrees. It is therefore supposed that this climate may be favourable to the growth of the arracacha. In 1821 plants were sent to the Horticultural Society, but they unfortunately died. Since that time, however, the introduction of this plant has been effected; and it is thriving in the garden of Dr. Hamilton, of Plymouth, who writes, in July, 1828, "My

* 'History of Jamaica.'



Different sorts of Yam Roots.

arracacha plant is flourishing beyond my most sanguine expectations in the open air; indeed, it grows much more luxuriantly in the open air than in the house."*

One of the substances of spontaneous growth, which is largely used as an article of food, is SAGO (*Sagus farinifera* and *Rumphii*, and other species). The substance known in commerce under the name of sago is a form of starch extracted from the trunk of a tree.

This tree is a native of the south-east of Asia, and of the islands of the Indian Ocean, where it grows spontaneously, and is perfected without any culture. This circumstance occurring with regard to a substance slightly nutritive, in a climate which disposes the human frame to inaction, occasions the adoption of sago in many places as the general food of the population, to the neglect of other plants, the cultivation of which would call for some amount of exertion.

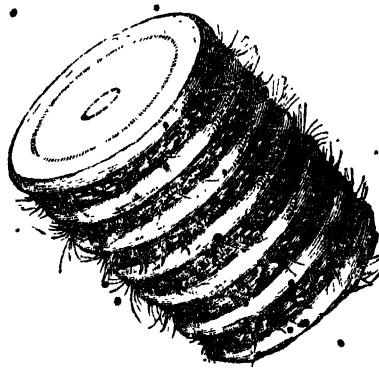
* 'Gard. Mag.,' vol. iv. p. 402.

The sago, or, as it is called in the Molucca Islands, the libley tree, is of peculiar growth. The trunk, which is formed of the bases of the leaves, grows at first very slowly, and is covered with thorns; so soon, however, as the stem is once formed, the growth of the tree proceeds with very great rapidity, so that it speedily attains its full height of thirty feet, with a girth of five or six feet, losing in this stage its thorny accompaniments. Like the cocoa-nut tree, the sago has no distinct bark that can be peeled off, but the trunk consists of a long, hard, ligneous tube, about two inches thick, the internal area of which is filled with a kind of farinaceous pith, intermixed with numerous longitudinal fibres. The maturity of the tree is known by the transpiration of a kind of whitish dust through the pores of the leaves; and when this appears the trunk is felled near to the ground.

The best account of this tree, and of the mode of preparing its pith for use as human food, is to be seen in Forrest's account of the Molucca Islands: it is to the following effect:—

"The tree being felled, is cut into lengths of five or six feet. A part of the hard wood is then sliced off, and the workman, coming to the pith, cuts across the longitudinal fibres and the pith together, leaving a part at each end uncut, so that when it is excavated there remains a trough, into which the pulp is again put, mixed with water, and beaten with a piece of wood. Then the fibres, separated from the pulp, float at top, and the flour subsides. After being cleared in this manner by several waters, the pulp is put into cylindrical baskets made of the leaves of the tree; and if it is to be kept some time, those baskets are generally sunk in fresh water to keep it moist. One tree will produce from two to four hundredweight of flour.

"We seldom or never see sago in Europe but in a granulated state. To bring it into this state from the flour, it must be first moistened and passed through a sieve into an iron pot (very shallow) held over a fire, which enables it to assume a globular form. Thus all our grained sago is half baked, and will keep long. The



Stem of the Sago Tree, showing the path from which the Sago is extracted.

pulp or powder of which this is made will also keep long if preserved from the air, but if exposed, it presently turns sour."*

We learn also from the same authority that loaves of bread are sometimes made in the Moluccas Islands of the pith of the sago, and that these loaves are baked in small ovens, "the floors of which are divided by means of partitions into cells about the size of an octavo volume."

The leaf of the sago is used in the same quarter for covering houses, and in that climate will not need to be renewed oftener than once in seven years.

When the sago tree is cut down, its vegetative power still remains in the root, which again puts forth its leaves and forms the trunk, and this proceeds again through its different stages until it is again subjected to the axe, and made to yield its alimentary contents for the service of man.

Sago is also produced from many varieties of palms, but the tree here described is that which furnishes the best. The produce of the *Cycas circinalis*, so often er-

* Forrest's 'Voyage to the Moluccas,' p. 39 second edition.

roneously mentioned as yielding the sago of commerce, is very inferior.

If the native of the Molucca Islands has his sago-bread without the labour of cultivating the plant which produces it, the Indian of the Cordilleras of South America has his supply of milk from a tree growing at a vast height amidst arid mountains, where no cattle can pasture. The *Cow-Tree* has been described by Humboldt with his characteristic spirit and accuracy; and it was much earlier noticed by Laet, a Dutch traveller, as growing in the province of Cumana. "On the side of a thirsty rock," says Humboldt, "grows a tree whose leaves are dry and husky. Its large roots penetrate with difficulty through the stony soil. During many months of the year not a shower waters its foliage; the branches appear withered and dead; but when its trunk is pierced, a sweet and nourishing milk flows from the wound. It is at the rising of the sun that this vegetable aliment is most plentiful. The natives and the black slaves then gather together from all parts with large wooden vessels to catch the milk, which as it flows becomes yellow, and thickens on the surface. Some make their abundant meal at the foot of the tree which supplies it; others carry their full vessels home to their children."*

In tropical countries the force of vegetation is so great, and the wants of society are so few, that magnificent trees are destroyed for the sake of a small portion of food, such as a few square feet of an English garden would produce.

The CABBAGE-PALM (*Areca oleracea*) is a most gigantic tree; its stem, which, near to its base, is about seven feet in circumference, ascends straight and tapering to a vast height. It is of a brown colour, hard, ligneous, divided into short joints, and pithy within like elder. Several feet from the summit the tree assumes a fluted form, and a green colour; which change is occasioned by the husky tegument that forms the petioles, which thence diverge far in a horizontal direction, like the

* 'Voyage aux Régions Equinoxiales,' tome v. p. 264.

crown of a pine-apple. These are decorated with numerous leaflets, some of which are about three feet long, and an inch and a half broad, tapering into a sharp point; the leaflets gradually decrease in size as they approach the extremities of the branches. This regular, lofty group of foliage, impelled by the most gentle gale, and constantly waving in feathery elegance, is an object of beauty which cannot be imagined by an inhabitant of temperate climes, unused to the magnificent vegetation of a tropical sun. The seed is inclosed in a brown spatha or sheath, which arises from the centre of the branches, and, hanging downwards, consists of small oval nuts, not unlike a bunch of dried grapes, but much longer in proportion to their circumference.

Within the leaves which surround the top of the trunk the *cabbage* lies concealed. It is white, about two or three feet long, as thick as a man's arm, and perfectly cylindrical. This substance is composed of longitudinal flakes like ribands, but so compact as to form a crisp, solid body. When eaten raw it resembles the almond in flavour, but is more tender and delicious. It is usually cut into pieces, boiled, and served as an auxiliary vegetable with meat.

To obtain this small portion, borne on the pinnacle of the tree, and hidden from the eye of man, the axe is applied to the stately trunk, and this majestic lord of the mountain-top is laid low, to furnish a small quantity of vegetable matter, which is "eaten like cauliflower," and which receives its distinctive name from our lowly cabbage. Surely this rivals the tales handed down to us of Roman epicurism!

In the cavity made in the trunk by the removal of the cabbage, a kind of black beetle deposits its spawn, from which grubs, which are called the palm-tree worms, are produced, and these, strange to say, are eaten as a great delicacy. Stedman gives the following account of this choice luxury of Guiana:—"Another negro also brought me a regale of *groe-groe*, or cabbage-tree worms, as they are called in Surinam. This reptile grows to the size and thickness of a man's thumb, and is extremely fat.

However disgusting to appearance, these worms are a delicious treat to many people, and they are regularly sold at Paramaribo. The manner of dressing them is by frying them in a pan with a very little butter and salt, or spitting them on a wooden skewer. In taste they partake of all the spices of India, as mace, cinnamon, cloves, nutmegs, &c. Several species of these worms are produced in all the palm-trees, when beginning to rot, but some are larger than others. They are all of a pale yellow colour, with black heads."*

Cabbage Palm (*Areca oleracea*)

* Stedman's 'Surinam,' vol. ii. p. 23.

CHAPTER XI.

TURNIP, CARROT, PARSNIP, ETC.

AMONGST the parts of plants which are eaten by man and many of the lower animals, are the roots of several plants. Most of the edible roots contain starch as a distinguishing ingredient; to this however is frequently added sugar. They contain also a large quantity of water, and only a small quantity of protein, so that they are not at all adapted for the entire subsistence of either man or animals. Of some of those which will be mentioned in this chapter, Dr. Lyon Playfair has given the following chemical analysis :—

100 lbs.	Water, &c.	Protein.	Carbonaceous matter.
Turnips contain	90	1	9
Carrots „	88	2	10
Beet-root „	70	1½	8½

From this analysis it will be seen how large a quantity of water these roots contain, and how little they are adapted for nutrition, and the properties of the whole class may be judged of by these examples.

The TURNIP (*Brassica rapa*). A species of turnip is to be occasionally found growing in a wild state in some parts of Britain; but the root of this plant is of no value, and experiments have proved that cultivation cannot, under an English sky at least, convert this wild variety into that of which the root is used as an edible substance.

The turnip was well known to the Romans, and all that can be gathered on this subject from the writings of the ancients renders it probable that it occupied nearly the same place in Roman culture as it does in

British husbandry in the present day. Columella* recommended that the growth of turnips should be abundant, because those which were not required for human food could be given with much advantage to cattle; and both Pliny and he concur in their testimony, that this produce was esteemed next to corn in utility and value. The best grew in the country of the Sabines, and were worth at Rome a sestertius (or two-pence) each.†

Flowers and Pods of the Turnip.

It is averred that the Roman method of cultivation must have been superior to that of the moderns, since Pliny relates that some single roots weighed as much as forty pounds, a weight far surpassing any which has been obtained by the most skilful modern agriculturists. Indeed, the large size of the Roman turnip is supposed

* 'De Re Rustica,' lib. ii. cap. 10.
† 'Hist. Nat.,' lib. 18, c. 43, lib. 19, c. 5.

by some authors to furnish a collateral proof of the colder temperature of Italy in ancient than in modern times. Speculations, however, raised upon what might perhaps have been an exaggerated statement of the Roman naturalist must be purely hypothetical. It is certainly found by experience that a warm climate is not so favourable to the growth of the turnip as cold moist regions. Though receiving equally careful culture, it does not attain to the same size in the south as in the north of England and in Scotland, while it thrives best in the west of the latter country, and in those parts of Ireland where the climate is the most humid. Though the colder parts of the temperate regions are found most favourable for this cultivation, the countries of still higher latitudes are not congenial to the growth of the turnip. Those arctic climes where the summer, though brief, is dry and warm, are decidedly adverse to its successful cultivation.

It is very probable that the garden culture of the turnip was introduced by the Romans into this country, and that, like some of the fruit-trees which they had transplanted here, though neglected, it was never altogether lost: and, if appearing to be so for a time, was restored by the monks, those constant guardians and fosterers of horticulture.

There is no doubt that this root was in cultivation in the sixteenth century. Whether revived by native industry, or introduced at that period by the Flemings, is a question differently answered by different writers; nor does the inquiry possess much interest. Turnips were partially grown for many years in this country before they came into extensive notice. Horticultural pursuits were at that time so little understood and practised here, that even the most successful issue which attended the cultivation of the turnip in Norfolk, a county peculiarly adapted to its growth, failed for a time to be followed by its more extended adoption; and a considerable period elapsed before it travelled out of Norfolk into Suffolk, and thence into Essex.

Towards the latter end of the sixteenth century it is

mentioned by more than one writer. Cogan, in his 'Haven of Health,' published in 1597, says, that "although many men love to eat turnips, yet do swine abhor them." Gerarde, who published in the same year, and who had rather more rational views on the subject of plants, leads us to conclude that more than one variety was cultivated in the environs of London at that time. "The small turnip," says he, "grown by a village near London, called Hackney, in a sandie ground, and brought to the Crosse in Cheapside, by the women of that village to be solde, are the best that I ever tasted." Gerarde is silent concerning the field culture of turnips; neither is this mentioned by Parkinson, who wrote in 1629. It is not until the close of the seventeenth century that we can find any account of this root being thus cultivated in any part of the country.

The turnip, in some of its varieties, is of very universal culture throughout Europe. In Sweden it is a very favourite vegetable. We also learn from the interesting journal of Linnæus, that even so far north as Lapmark the colonists sow annually a considerable quantity of turnip-seed, which frequently succeeds very well, and produces a plentiful crop. The native Laplanders are so fond of this root that they are often induced to part with a whole cheese in exchange for one single turnip, "than which nothing," our author adds, "can be more foolish."*

In Russia turnips are used as fruit, and eaten with avidity by all classes. In the houses of the nobility, the raw turnip cut in slices is handed about on a silver salver, with brandy, as a provocative to the more substantial meal. "The first nobleman of the empire," says Dr. Clarke, "when dismissed by his sovereign from attendance upon his person, may be found throughout the day with his neck bare, his beard lengthened, his body wrapped in a sheep's-skin, eating raw turnips, and drinking quass."†

It is said that the root of the turnip cultivated in the

* Vol. i. p. 174.

† Clarke's 'Travels in Russia,' vol. i. p. 46.

plains of Germany seldom exceeds half a pound in weight; and that in France, and countries still farther to the south, they are yet more diminutive. These are, however, no doubt a variety, perhaps a species, naturally of a small growth, and it must not thence be inferred that hot countries are wholly inimical to this production. At Benares, in Hindustan, a latitude of about 26°, turnips, radishes, asparagus, cauliflowers, and other garden vegetables are raised in considerable plenty by the natives, and exposed to sale in the bazaars, principally for European purchasers,* to whom these plants of home association are welcome even among the rich display of tropical productions, and even though they cannot be obtained in their native excellence, being comparatively tasteless when raised under the fervid sun of India.

The turnip is a biennial plant; the appearance of its large radical leaves is familiar to everybody. In the second season after sowing, a flowering stem shoots up, which bears flowers having the four petals arranged in the form of a cross, and therefore called cruciform. The varieties both under garden and field culture are very numerous; while these again differ with soil and climate, and manner of cultivation. When destined for human food, of course the quality more than the size is considered; but in raising them as an economic aliment for cattle the greatest possible quantity of nourishment which can be produced in a given space is the object most to be desired. Various sorts, differing in size, shape, and colour, but all assuming, in a greater or less degree, the globular or spheroidal form, are the objects of either garden or field culture. Of these there are ten varieties in common cultivation, distinguished by colour, size, time of coming to maturity, productiveness, or flavour. Among this number, the Maltese golden turnip is a very fine variety, of one uniform orange tinge. It is perfectly spherical, and the crown and tap-root are both so very small, that if dexterously removed the exact parts of the root whence they were divided are not easily dis-

* Tennant's 'Indian Recreations.'

cernible. When quite fresh, and just before it has acquired its full consistence, it makes its appearance in the northern parts of the country with the dessert, and it is considered to be superior both in form and flavour to many fruits. The Swedish turnip is another variety of a much larger growth, and of a more hardy nature than any of the other kinds under cultivation; this is very seldom raised among garden vegetables, as it is too strong and harsh to be acceptable for human food. It has, however, the advantage of surviving through seasons when even the hardiest of the others would be destroyed. This turnip is largely cultivated in fields and employed as food for cattle.

The root of the French turnip, or *naveu*, differs from the other varieties, having more the appearance, in shape and size, of the carrot. It is of a very fine flavour, and in high repute on the Continent. When used, the outer rind is not peeled off as in the common turnip, but merely scraped, since the peculiar taste chiefly resides in that part. In France, as well as in Germany, few great dinners are set on the table without this vegetable appearing under some form, either enriching the gravies and stews, or prepared as a viand by itself.* The naveu was more cultivated in this country a century ago than it is at present, being now but rarely found in our gardens.

In Barbary a small parsnip-like turnip with fibrous roots, called in that country *el bashoure*, is held in much esteem for its agreeable pungency.†

A light gravelly soil, broken fine by tillage, is most favourable to the production of turnips of the best quality; but they will succeed in almost any land. Any poor, light, sandy ground suits the naveu, which has the great advantage of never requiring any manure in its cultivation.

Turnips may be obtained in this country in succession almost throughout the year by sowing seed every month in spring and summer. This is distributed broad-cast, or sometimes sown in drills in the proportion of about

* Hort. Trans. † Shaw's 'Travels.'

half an ounce of seed to one hundred square feet. As soon as the plants are sufficiently advanced, having rough leaves of about an inch broad, they are hoed and thinned to six or eight inches apart from each other. In the early stages of their growth turnips are rather a delicate crop. When they first put forth their tender and succulent seed-leaves they are liable to be preyed upon by a peculiar species of beetle called thence the turnip-fly; this is extremely destructive, and various preventives against the evil have been suggested. Several preparations of the seeds previously to sowing have by turns been recommended, such as steeping them in sulphur-water or sprinkling them with soot at the time of sowing; these, however, have not been considered efficacious, and even when they have apparently been successful, perhaps it has been under circumstances in which the plants would have equally escaped without any precautionary measure. No insect can very well deposit its eggs in the seed of the turnip before it is in the ground, at least there is no known species which perforates the pods for that purpose. The sulphur or soot, or any other application, is of course thrown off with the tunic or outer coat, and does not in any way protect the cotyledon or side lobes of the seed, which come up in the form of leaves, and in which the eggs of the fly are then deposited. By some cultivators these leaves are powdered with quick-lime as soon as they show themselves above ground; a plan which appears the most rational for preventing the mischief. One of the easiest remedies against it, however, is recommended by Neill, to sow thick, and thus ensure a sufficiency of plants both for the fly and the crop. As soon as the rough leaves are a little developed the danger from the insect depredator ceases.

Turnips, if carefully cultivated, attain to a very great size in this country, though appearing insignificant when compared with the gigantic root of the Roman naturalist. Tull* speaks of some weighing as much as nineteen pounds, and of often meeting with others of sixteen

* Tull's 'Horse-Hoeing Husbandry.'

pounds. In Surrey, a Swedish turnip, the seed of which had been sown in July, was dug up in October, 1828, which weighed twenty-one pounds, and was one yard in circumference.* But these are far surpassed by one which was pulled up in 1758 at Tudenham, in Norfolk, and which weighed twenty-nine pounds.† In No. 360 of the 'Philosophical Transactions' we find a curious calculation made by Dr. Desaguliers, on the rapid increase of a turnip root. One ounce of turnip-seed was found by him to contain between fourteen and fifteen thousand single seeds; therefore, one seed would weigh one-fourteen or one fifteen-thousandth part of an ounce; and assuming its growth to be always uniform, a turnip-seed may increase fifteen times its own weight in a minute! By an actual experiment made on moss or peat ground, turnips have been found to increase by growth 15,990 times the weight of their seeds each day they stood upon it. It is not, however, only the size and weight of the root which renders this crop so productive; the number contained in a given space, with reference to their size, is very great. Some writers speak rather marvellously on this subject, but it is generally thought a good crop to obtain a turnip from each square foot of ground. Mill considers an average crop to be 11,664 roots per acre, which at six pounds each will be 69,984 pounds.

The uses of the turnip as a culinary vegetable are too familiarly known to require that they should be here enumerated. Though in very extensive favour among the moderns, the different modes of preparing it appear poor and insipid compared with those efforts of gastronomic skill by which the ancients made it assume so many inviting forms. It is related that "the king of Bithynia, in some expedition against the Scythians, in the winter, and at a great distance from the sea, had a violent longing for a small fish called *aphy*—a pilchard, a herring, or an anchovy. His cook cut a turnip to the perfect imitation of its shape; then, fried in oil, salted, and well powdered with the grains of a dozen black

* 'Gard. Mag.' † Campbell's 'Pol. Survey,' vol. ii.

poppies, his majesty's taste was so exquisitely deceived, that he praised the root to his guest as an excellent fish. This transmutation of vegetables into meat or fish is a province of the culinary art which we appear to have lost; yet these are *cibi innocentes* (harmless food) compared with the things themselves."*

Our more immediate ancestors appear to have applied the turnip to more extensive uses as an esculent than is done in the present day. It is recorded † that in the years 1629 and 1630, when there was a dearth in England, very good, white, lasting, and wholesome bread was made of boiled turnips, deprived of their moisture by pressure, and then kneaded with an equal quantity of wheaten flour, the whole forming what was called turnip-bread. The scarcity of corn in 1693 obliged the poor people of Essex again to have recourse to this species of food. This bread could not, it is said, be distinguished by the eye from a wheaten loaf; neither did the smell much betray it, especially when cold.

The earliest spring-produced leaves of the turnip are sometimes boiled or stewed, and appear on the table under the name of turnip-tops. The Romans likewise applied these tender leaves to the same purpose.

Turnips, in all their varieties, do not contain so much nourishment as either carrots or parsnips.

The CARROT (*Daucus carota*). It was a subject of much interest among the botanists of the sixteenth and seventeenth centuries to ascertain what plants of the ancients could be identified with those at present known. Accordingly we find in the works of those writers many curious and learned disquisitions in support of their respective opinions. Among the plants which have given rise to so much laborious, and perhaps unprofitable research, the carrot makes a prominent figure. This discussion would have little interest in the present day; the result, however, shows that the carrot was certainly known and used by the ancients as an edible root. A

* 'Curiosities of Literature,' vol. v. p. 88.
† 'Phil. Trans.,' Nos. 90 and 205.

plant under the name of *staphylinos* is minutely described by Dioscorides,* and this description applies in every respect to that of the carrot. Though growing wild, the plant is noticed by the Greek physician as being likewise reared in gardens on account of its esculent root. It is difficult to trace the progress of the carrot since that period, but it appears to have been always an object of cultivation among various nations.

Umbel of the Carrot.

Miller and other horticulturists have made various attempts to change by culture the wild carrot into the esculent one; these attempts have, however, always proved unsuccessful—it is therefore probable that the two plants are not identical, or that the cultivated one was first fostered into its present value under a warmer temperature than that of Britain. Whatever may be its origin, it was not, however, immediately transplanted into this country from a milder climate than our own. We are indebted for its introduction to the Flemings,

* Dioscorides, lib. iii. cap. 52; Theophrastus, 'Hist. Plant.,' ib. ix. cap. 15.

who, in the reign of Queen Elizabeth, sought refuge in England from the insupportable tyranny of their Spanish master Philip the Second. Finding the soil about Sandwich in Kent very favourable for the culture of the carrot, the emigrants soon engaged in its production on that spot. The English, whose knowledge of horticulture was at that time extremely circumscribed, were in this case well pleased to add another edible vegetable to the scanty list which were then under general cultivation. The carrot, therefore, unlike the turnip, grew quickly into esteem, and being made an object of careful culture, was very shortly naturalized throughout the island. We are told by Parkinson, the celebrated botanist to James the First, that in his time the ladies adorned their headdresses with carrot-leaves, the light feathery verdure of which caused them to be no contemptible substitute for the plumage of birds. Although the taste of the fair sex in the present day has discarded this simple and perishable ornament, the leaves of the carrot are even now sometimes used as house decorations. If in the winter a section be cut from the end of thick part of the root, and this be placed in a shallow vessel containing water, young and delicate leaves are developed, forming a "radiated tuft," the graceful and verdant appearance of which makes it a pleasing ornament for the mantel-piece in that season when any semblance of vegetation is a welcome relief to the eye.

The carrot is a biennial plant, attaining to the height of two feet; its white flowers grow in umbels, that is, having the common peduncle divided into rays springing from one point, each ray or pedicle being terminated by a floret; they appear in June and July, and are succeeded by rough hairy grains.

Of cultivated carrots there are many varieties, which have in all probability been produced by climate and culture. The kinds which are commonly grown are distinguished into two, the long and the horn carrot. The first is again subdivided into others which differ in size as well as in colour. The red or large field carrot attains to a considerable growth; it is chiefly cultivated in fields

as food for cattle, and in farmers' gardens as a material for colouring butter. The orange carrot, though not so productive, is generally the main crop in garden culture —the flavour of this is more delicate, and therefore it is in higher estimation as a culinary vegetable. There are, likewise, white, yellow, and purple varieties—these are not, however, in common cultivation. The horn-carrot has a shorter and smaller root than the long varieties; it is, therefore, a good crop for a shallow soil, and in such a situation is preferable to the larger kind; it has likewise the advantage of coming to maturity in a shorter period than the long, and is consequently found well adapted for the early and late crops.

When a carrot is cut transversely it is found to consist of two parts of different colour and texture. These are the bark and the wood; the bark is of the darkest colour, and of the most pulpy consistence, and it is also the sweetest to the taste; the heart or wood, especially when the root has attained its full size, is more fibrous or stringy, and, if it be separated, it is bristled over with hard points or fibres that extend to the rootlets outside. Almost the whole crown of the root, or the part which sends up the leaves, is connected with the wood, and only the epidermis of the leaves and stem with the external portion of the root.

The skin or bark is found to be more nutritious than the central part, and consequently the value of the carrot as an esculent will depend on the relative proportion of these two parts of the root. The object of the skilful cultivator is, therefore, to obtain the root with the smallest possible proportionate quantity of wood. In endeavouring to secure this result much must of course depend upon the nature of the plants from which the seeds are obtained; but adaptation of soil is likewise a very important consideration.

The carrot is most successfully cultivated in a light mellow soil mixed with sand: the ground should be well dug to some depth, and made extremely friable and porous, that the roots may meet with no obstruction in running down, which would cause them to grow forked

and to shoot out lateral branches. This accident will happen, especially when the ground has been too highly manured previously to the seed being sown. It may perhaps be taken as a general rule that strong soils are not well adapted for any plants which form esculent roots deep under the surface, as the mechanical resistance which is thereby opposed to the swelling of the root forces much of the strength of the plant up into leaves; and in the carrot especially, that part of the root which is the most valuable is diminished in the greatest proportion.

The best mode of cultivating these roots has been made by many agriculturists a subject of inquiry. So early as the year 1765, this branch of husbandry engaged the attention of the Society for the Encouragement of Arts, &c.; and, in consequence, an account of the culture of carrots and the uses to which they may be applied was published by Robert Billing, a farmer, of Norfolk, in whose work much useful matter on the subject is contained.

The seeds of carrots are surrounded by numerous forked hairs, by which they adhere to each other so tenaciously, that there is some difficulty in causing their separation; this is performed either by rubbing them through the hands or by passing them through a fine chaff-sieve; but the best and most effectual method, as recommended by an intelligent cultivator,* is to mix them with fine sand in the proportion of one bushel to every four or five pounds of seeds—this mixture is then laid in heaps, being occasionally watered and turned during two or three weeks previous to sowing. The above preliminary process not only occasions the more equal diffusion of the seeds, but likewise promotes their quicker germination; besides this, when they are sown alone their extreme levity causes great inconvenience, and prevents this operation from being successfully performed except in the calmest weather. The ground being duly manured, and reduced to the required degree of fineness,

* 'Communications to the Agricultural Society,' vol. ii.

the seed mixed with the sand is sown about the middle of March or beginning of April: the seeds thus prepared germinate and send up young plants before the appearance of the annual weeds, which are always abundant in a soil so worked and manured. In about five or six weeks the plants are in a fit state for hoeing, and that operation two or three times repeated, according to the increase of the weeds, is all the after-culture which is requisite.

From this manner of sowing, more than eight hundred bushels per acre of carrots of very large growth have been obtained. According to Mr. Arthur Young, the produce of these roots on indifferent land is about two hundred bushels, and on a more congenial soil six hundred and forty bushels per acre. The garden culture of carrots is somewhat different. In that case they are sown in a succession of crops from the latter end of February to the beginning of August, and the plants when hoed are thinned at regular distances of from five to eight inches apart, the particular interval being regulated by the size of the variety under cultivation, and by the period of their growth at which they are to be drawn.

In order to preserve carrots for winter use, they are dug up in the beginning of November, and placed in a dry place in sand, by which means they may be kept without spoiling until March or April of the ensuing year.

To obtain carrot seed, some roots which have been taken up in November are replanted in February about two feet apart, and with the crown or head a few inches below the surface. Leaves and flower-stalks will spring up from these, and seeds will be produced which ripen in autumn. A considerable quantity of carrot-seed is raised at Weathersfield in Essex, but this is insufficient for a home supply, and it is said much is imported from Holland into this country.* It would appear that the production of carrot-seed may occasionally be made a source of considerable profit to the cultivator. We find it recorded that in the latter half of the last century a

* Loudon's 'Encyc. of Gardening.'

farmer in Essex obtained from an acre of land sown with carrots ten hundredweight of seed, which he sold in London for 10*l.* per hundredweight.* This is a very rare case. If it were general, the price would soon be reduced.

The size of carrots differs, of course, very much according to soil, culture, and variety. Some have been known to measure two feet in length and from twelve to fourteen inches in circumference at the thickest part. In the autumn of 1826 several were taken up in the neighbourhood of Lancaster having an average weight of four pounds each; these were fine firm roots, and in every respect good for the table.

Besides their use as human food, carrots are in some places grown largely for the consumption of stock, especially for horses. It is affirmed that cattle which have once tasted these, usually prefer them so much to turnips as with difficulty to be made to return to the latter. The milk of cows fed on carrots never acquires any unpleasant flavour, while at the same time the quantity produced is increased. Calves thrive admirably, and bullocks are quickly fattened on this food. Carrots are equally beneficial as nourishment for sheep, and are devoured with avidity by swine. In the short space of ten days a lean hog was fattened by these roots, having consumed during that period one hundred and ninety-six pounds. Its fat proved very fine, white, and firm, and did not waste in the dressing. Horses receiving no other sustenance perform their work as usual without any diminution of their sleekness. The efficacy of these roots in preserving and restoring the wind of horses had, it is said, been partially known in Suffolk, where carrots were administered as a secret specific for the complaint, long previously to their being commonly applied as food for horses. These roots may also with advantage be given to poultry. In severe winters they have been found of great utility in the preservation of deer; and they have been strongly recommended as wholesome and cheap nourishment for dogs

* Campbell's 'Political Survey.'

Various opinions exist among agriculturists as to the relative advantages arising from the culture of the carrot or the turnip as food for cattle. The latter root may perhaps be more productive, and succeed better in a variety of soils, but the amount of nourishment it contains is much less than that of the carrot. This assertion rests not alone on chemical evidence, but also on the testimony of Mr. Billing, who obtained from twenty and a half acres of land, varying in soil and degree of preparation, five hundred and ten loads of carrots. Experience led him to conclude that these were equal in use and effect to one thousand loads of turnips, and to three hundred loads of hay. At Parlington in Yorkshire, the stock of a farm, consisting of twenty working horses, four bullocks, and six milch cows, were fed from the end of September to the beginning of May on the carrots produced from three acres of land. The animals, during the whole of that period, lived on these roots with the addition of only a very small quantity of hay, and thirty hogs were fattened on the refuse left by the cattle.

The greater part of the alimentary portion of the carrot consists, according to Sir Humphry Davy's analysis, of saccharine matter. The quantity of protein is two per cent. in the whole weight of carrot, and ten per cent. of starch and saccharine matter. The quantity of ready formed saccharine matter in carrots is much greater than in any of the cerealia, being two and a half per cent. more than in barley, and about six times more than the quantity contained in potatoes. It is presumed, therefore, that carrots are much better adapted than the latter for the distillery. Dr. Hunter, in the 'Georgical Essays,' details experiments made to prepare from carrots a beverage resembling beer, and subsequently a spirituous liquor; the former proved unsuccessful; but the result of the latter was, according to the Doctor's opinion, very encouraging. "From a gross calculation," he concludes, "I am induced to think that a good acre of carrots manufactured in this manner will leave a profit of forty pounds, after deducting the landlord's rent, the cost of cultivation, distillation, and other incidental ex-

penses. In this calculation I presume that the spirit is worth six shillings per gallon, and not excised." This is perhaps rather an exaggerated statement: it has, however, been found by other experiments that eighteen tons, the produce of one acre, will yield one hundred gallons of proof spirit, a larger product than that obtained from an acre of barley;* while the refuse supplies a greater quantity of food for hogs.

Attempts have been made to prepare sugar from carrots, but without success, a thick syrupy matter which refuses to crystallize can alone be obtained.

The PARSNIP (*Pastinaca sativa*) is, like the carrot, a biennial, and is also a native of Britain. It belongs to the same tribe of plants (*Umbelliferæ*) as the carrot, and resembles it in its general characteristics. The leaves are, however, larger, the parts not being so delicately formed, and the whole plant is more strong and hardy. The flowers are yellow, while those of the carrot are white, with a tinge of purple in the middle.

One variety only of the parsnip is cultivated in England, though that runs into many sub-varieties, according to the soil upon which it is grown. In other countries the varieties are more numerous. In France, as well as in Guernsey and Jersey, where the soil is peculiarly adapted to this cultivation, three varieties are distinguished by the names of *Coquaine*, *Lisbonaise*, and *Siam*. The first runs very long, to the depth of three and even four feet in the ground, and attaining to from three to four inches in diameter; while its leaves grow proportionally high, and proceed from the whole crown of the root. The *Lisbonaise* is shorter, but considerably thicker,

* The average product assigned to twelve stone or one hundred and sixty-eight lbs. of malt, is about six gallons and three-quarters, imperial measure, of spirit twenty-four per cent. over proof; thus giving about two gallons as the product of a bushel. According to this calculation, an acre of barley should produce sixty gallons of spirit of the strength above mentioned, which is equal to seventy-four gallons of proof spirit, imperial measure, or eighty nine gallons of the old wine-measure.

and of an equally good quality: the leaves of this variety are small and short, and proceed only from the centre of the crown. The *Siam* has not so large a root, and is of a slightly yellow tinge; it is more tender, and of a richer flavour than the other varieties.

A light deep soil, free from stones, is requisite for the favourable growth of the parsnip. The seed is usually sown at the latter end of February or March, in the proportion of nearly three and a half pounds of seed to one rood of land. It is sown broad-cast, and raked into the ground. The only after-culture required is to keep the plants free from weeds, and to thin them to about a foot distance from each other. The roots come to maturity at the latter end of October: this state is indicated by the decay of the leaf; they are then fit for use. Parsnips are not so susceptible to injury from frost as carrots, and they may therefore remain throughout the winter in the ground without being in any way deteriorated.

A few roots should, however, be preserved in sand for use during those months when the ground is too hard to allow of their being dug up. The seed is obtained in the same manner as that of the carrot.

When the parsnip is grown upon poor land it loses much of the rank taste which it acquires if cultivated in richer soils, and though not nearly so abundant, is far more sweet and agreeable. Thus produced, when slowly roasted in the ashes of peat or turf, it becomes nearly as farinaceous as the best potatoes, and in some of the poorer districts of the country is used with the same additions as an article of substantive food. "In the north of Scotland," Neill observes, "parsnips are often beat up with potatoes and a little butter: of this excellent mess the children of the peasantry are very fond, and they do not fail to thrive upon it." From the same authority we learn that in the north of Ireland an agreeable beverage is prepared from the roots brewed with hops. In some places a species of wine is also made from them, and a very pure spirit is obtained when parsnips are distilled after a similar preparatory process.

to that used with the carrot. In Catholic countries the parsnip is more abundantly employed for human food than in Britain. It was, however, formerly held in much greater estimation here than it is at present. This root is wholesome as well as hardy, but as the soil which is most favourable to its production as human food is also best adapted for the growth of the potato, which is both more productive and more nutritious than the parsnip, the culture of this plant as a culinary esculent has declined; and the use of it with salt-fish in Lent may perhaps be regarded more as the relic of an old custom than as a choice arising from any partiality for the peculiar flavour of the parsnip in combination with this particular kind of viand.

The alimentary matter in parsnips is found by analysis to be ninety-nine parts in a thousand, of which nine parts are mucilage, and the remaining ninety are saccharine matter. The quantity of protein has not hitherto been estimated, but it is probably of the same amount as in carrots.

The SKIRRET (*Sium Sisarum*) differs from the roots already mentioned in being a perennial. This plant is not a native of England, or of any part of Europe. It is indigenous to China, but was introduced into this part of the world some centuries back, being known in British horticulture so early as about the middle of the sixteenth century. It was formerly much more prized than it is at present. Worlidge, a writer in the latter end of the seventeenth century, described it as the "sweetest, whitest, and most wholesome of roots." The skirret is one of those plants which are now neglected; because we are become acquainted with others more pleasant to the taste and more profitable in their culture. Its peculiar sweetness, so delightful to the palates of our less-refined forefathers, to us appears nauseous lusciousness; and that root which the Emperor Tiberius esteemed so much as to cause it to be brought from the banks of the Rhine for the use of his table, is little relished in the present day. Beckmann ingeniously accounts for this change of taste in the use of vegetable productions.

"In the oldest times mankind were so fond of sweet things, that the goodness and agreeable taste of every kind of food was determined according to the degree of its sweetness; and such is the manner of judging, even at present, throughout all the East, in Africa, and in America. This is the case also among us with the greater part of the lower classes, who are not able to follow the mode of richer tables. In the northern countries this taste is almost everywhere prevalent. Thus the Swedes spoil, by the addition of sugar, costly Rhenish wines, sauer-kraut, and other articles, the agreeable tartness of which is gratifying to other nations. In proportion to their population and luxury the Swedes seem to use more sugar than the Germans, and the Germans more than the English or French; and one might almost suspect that a taste for sweet things was in the inverse ratio of culture. At any rate, one can thus explain why many vegetable productions which some centuries ago were reckoned among the most agreeable dishes appear to us to be nauseously sweet."*

For some time after the cultivation of skirrets had become neglected in the gardens of the rich, they still continued to be an object of culture among the poor in a few remote parts of the country. But even in those situations they have now very generally given way to the potato, and are seldom grown, and even then rather from the love of variety than for any particular merit which they may possess. The skirret is thus occasionally cultivated in the north of Scotland, under the name of *crummack*.

This plant is small compared with the carrot and parsnip, and belongs to the same natural order (*Umbelliferæ*). It has pinnated leaves, consisting of two or three pair of long dentated leaflets, and terminated by an odd one. The flower-stalk rises to the height of about two feet, breaking out at top into branches, each terminating in an umbel of small white flowers. The root consists of a cluster of fleshy fibres, which are connected

* 'History of Inventions,' vol. iv. p. 358.

Flowers and Roots of the Skirrot.

together at the crown or head, and in the course of a few years augment to a considerable bunch. Each separate tuber is about the thickness of the little finger. They grow very uneven, and are covered with a whitish rough bark, while a hard core or pith runs through the centre.

This plant is propagated either by seeds or by offsets from the parent root; the first method is considered the preferable one for obtaining good and tender roots.

The skirret abounds in saccharine matter. Mr. Margraaf extracted from half a pound of this root one ounce and a half of pure sugar.

The BEET (*Beta*) was known as an esculent root in the time of Pliny, who has given an accurate description of it in his work. The period when this plant was first introduced into Britain as a garden vegetable is not ascertained. It was cultivated at Lambeth by Tradescant the younger in 1656; but there is no reason for supposing that he was the first cultivator; on the contrary, it is more than probable that the beet was brought into this country by the Romans, and that it has continued since that period to be an object of partial cultivation.

The cultivated beets, in all their varieties, are plants of the same duration, and nearly of the same habits, as turnips. They are sown in the early part of the summer, bulb towards the close of the season, and, if allowed to stand, send up their flowering stems, and ripen their seeds in the following year.

The variety which has its root red throughout its whole substance is most used in England for culinary purposes. This plant is said to be a native of the warmer countries of Europe, but it is sufficiently hardy to bear the climate of most parts of Britain. The root is in the form of a carrot, but thicker in proportion to its length, those of a foot long often being three or four inches in diameter. It is very juicy, and, when wounded, bleeds freely a limpid fluid of a beautiful purple colour. The leaves are large, long, and succulent, and generally have a red or purple tinge. When eaten warm, beet-root has rather a mawkish flavour; it is, therefore, usually eaten cold, cut in slices, after having been previously boiled, and, with the addition of vinegar, is by some persons found agreeable to the palate. Its culture, as an esculent, has not, however, increased of late years, and it is not generally a favourite vegetable for the table. Nearly twelve per cent. of the whole weight of the beet is saccharine matter, which is a much greater proportion than is contained in any other European esculent. The quantity contained in the red and the white beet is nearly the same; the proportion of mucilage in each is likewise almost equal, the red having rather the advan-

tage, while it has nearly three times as much gluten (protein) as the white.

In a country like Britain, where with the bulk of the people vegetables are esteemed for their agreeable flavour, rather than for their nutritive qualities, the superiority of the beet, in the latter respect, is disregarded, and those roots which are considered more savoury obtain the preference.

From one variety of this root, which has a red skin, but is internally white, sugar is extensively prepared in France. We shall notice this manufacture in a subsequent chapter.

The white beet is seldom, if ever, used as human food, but is largely cultivated for the nourishment of domestic animals, and is preferred for this purpose to the turnip or carrot, especially in the vicinity of populous towns. The field-turnip is esculent when young; the carrot is so in all stages of its growth; and therefore when grown amid a thick population, they form a great temptation to petty depredators, by whom the farmer finds this provender for his cattle much diminished. The field-beet, however, affords no allurement to the hungry plunderer, as starvation itself could scarcely induce him to make a meal of this harsh, coarse root, previously to its being subjected to culinary preparation, and even then it would prove a most unpalatable repast. When cows are fed with the beet, it is said that they yield a greater quantity of milk in consequence; and this food does not impart any of that rank flavour which is communicated by turnips.

There are several varieties of the field-beet: some with the stem, branches, and veins of the leaves red; others with leaves wholly red; and some, again, with the epidermis of the root in different shades of red, brown, and yellow. Those coloured varieties are considered more hardy than the white; and one, having a reddish skin, the *mangold* or *mangol wurtzel* of the Germans, is said to produce the largest roots and the most weighty crop in a given space of land. In Guernsey crops have been raised of one hundred tons per acre.*

* 'Gard. Mag.,' vol. iv.

Some varieties of white beet are cultivated in the gardens for their leaves alone; these are larger than the leaves of the red beet, and are more thick and succulent; they are boiled as spinach, and put into soups. One kind, called the great white or sweet beet, is esteemed for the footstalks and midribs of the leaves, which are stewed and eaten under the name of Swiss *chard*, or *poitée aux carotes*.

The Jerusalem Artichoke (*Helianthus tuberosus*) belongs to the natural order *Compositæ*. It is a native of Brazil, and was first introduced in 1667 into this country, where it was much esteemed before potatoes were brought into general adoption. It is of the same genus, and has the same appearance, as the common sunflower, except that it attains to a greater height, often being ten or twelve feet high. Its name is derived from the similarity of flavour observable between these roots and the bottom of the artichoke. Its distinctive epithet is a corruption of the Italian word for sunflower, *girasole*, from *girare*, "to turn," and *sol*, the "sun;" and bears no reference, as many have imagined, to the city of Jerusalem.

The period of its flowering is autumn; but though the roots bear unhurt our severest winters, the plant rarely blooms in this country, and, even then, its seeds never come to maturity. The root is composed of many tubers, growing in a cluster; and so prolific is this plant, that there are often from thirty to fifty of these tubers attached to one stem. No care is required in its culture. If, when digging up the roots, the smallest piece of a tuber be left, a plant will spring from it, thus propagating itself almost in the manner of a weed; so that after it has once found entrance in a garden, there is no little difficulty in extirpating it thence. This plant, however, repays cultivation, and much better roots are obtained from regular setting than from its spontaneous growth. Cuttings of the tubers are planted in the same manner as potatoes in any of the spring months: the crop can be used in September, and taken up in November for winter supply. This root seems to meet with

Flower and Root of Scorzonera

undue neglect in our gardens; for it is an excellent winter vegetable, which may be grown abundantly at very little cost: it is wholesome, nutritious, and savoury; and, either boiled or stewed, affords a very agreeable variety for the table. These tubers resemble potatoes in being of one homogeneous substance; and are likewise eaten in their matured state.

Scorzonera (*Scorzonera hispanica*) also belongs to the natural order, *Compositæ*. It is indigenous to Spain, and was introduced into this country some years after the skirret, and, like it, was formerly more cultivated than it is at present. Its root has not, however, the peculiar

sweetness of the latter, but is extremely delicate, and when properly prepared makes so pleasant an addition to the list of culinary vegetables, that it appears to be unjustly excluded from our gardens. It has shared the fate of those vegetables which, according to Beckmann, have been banished by fashion; "for this tyrant, which rules with universal sway, commands the taste, as well as the smell, to consider as intolerable, articles to which our ancestors had a peculiar attachment."

Scorzonera was first known on account of its supposed medicinal properties, but was afterwards cultivated as food in consequence of its agreeable flavour. It was applied to this first purpose in the middle of the sixteenth century in Spain, where it was esteemed as an antidote to the poison of a snake, called there *scurzo*. A Moor, it is said, who had learnt in Africa that this plant possessed so valuable a property, availed himself of the knowledge in effecting many cures with the juices of the leaves and roots upon peasants who had while mowing been bitten by these venomous reptiles; but he carefully concealed the plant, that he might retain to himself all the honour and the profit attendant on the discovery. He was, however, clandestinely followed to the mountains, where he was observed to collect this plant, to which the name of scurzonera or scorzonera was then given, from the name of the snake, the venom of which it was believed to render innocuous. The knowledge was quickly disseminated. Petrus Cannizer transmitted the plant, together with a drawing of it, to John Oderick Melchion, physician to the Queen of Bohemia; and he, in his turn, lost no time in sending it to Matthioli, who had not any previous knowledge of the plant.* Soon after this Nicholas Monardes published a tract, in which the particular virtue of these roots was panegyrized. It is probable that in Spain their adaptation as an edible substance was likewise first discovered; and thence, about the beginning of the seventeenth century, it was introduced into France. The author of 'Le Jardinier

* 'Matthioli Epistol. Medicinal.'

François,' who was a practical as well as theoretical gardener, assigns to his own exertions its first cultivation in the French gardens.*

Scorzonera is at present much more used on the Continent than in this country. Its medicinal virtues are now, however, but little regarded.

This plant is a hardy perennial, with a stem from two to three feet long, and having yellow flowers, which continue to bloom from June to August. The lower leaves, which are linear and pointed, are about eight or nine inches in length. The root is thin and spindle-shaped, covered with a dark brown skin, but white within, and containing a milky juice.

Though the plants are perennial, producing offsets from the crown of the root, it is better to propagate from seeds, in the same manner in which carrots are cultivated, since the offsets degenerate from year to year, both in size and quality. The roots, like those of parsnips, remain uninjured in the ground throughout the winter, and till they begin to put out fresh leaves in the spring. The whole plant is somewhat bitter. To divest the roots of that quality, they are scraped, and then steeped in water previously to their being made to undergo any culinary process.

* "The first edition of his book, which greatly contributed to improve gardening in France, was printed in 1616."—*Beckmann.*

CHAPTER XII.

CABBAGE, SPINACH, ASPARAGUS, SEA-KALE, ARTICHOKE, ETC.

MANY other parts of plants besides the roots and root-stocks contain starch and other alimentary matters, which cause them to be eaten by man. The parts of the plants which we shall now mention, which are eaten, are the leaves, flowers, and young shoots. Some of these are previously cooked, whilst others are eaten uncooked, or as salads. These plants have not been submitted to a rigorous chemical analysis, but they are all known to contain starch; and this is probably the constituent which recommends them in the diet of man. In addition to starch, they possess small quantities of protein; and in the Cruciferæ, as the cabbage, &c., and the asparagus, this principle is found in the form of albumen. The albumen, however, does not exist in sufficient quantities to render any of them an efficient nutritious diet for man.

The CABBAGE (*Brassica oleracea*).

Some varieties of the cabbage have been cultivated from the very earliest times of which we have any record. But the migrations and changes of the best sorts have not been traced: neither is it at all probable that the varieties which the ancients enjoyed have descended to us unaltered. This particular genus of plants is peculiarly liable "to sport or run into varieties and monstrosities." They belong to the numerous family *Cruciferæ*. The cruciferous esculents form a much longer list than those bearing umbels; they are applied to a greater number of purposes, and afford an addition to food in a

greater number of forms, ages, and parts of the plant. The roots, the leaves, the stems, the buds, are eaten raw, or dressed in various ways; and the seed of many species are valuable on account of the oil which they afford. None of the family are poisonous. The *Cruciferæ* being found as weeds in almost every field, constant changes are produced, even in those plants under cultivation by crosses with the pollen of wild plants; while soil, culture, and climate exert a powerful influence over the different species, altogether causing varieties and sub-varieties, of which it would be a hopeless task to attempt the enumeration.

It is probable that some species of Brassica was first introduced into this country by the Romans, since *kale* is mentioned among the oldest English records. It is well known that "Brassica" was in very common cultivation at Rome, where, according to Columella, it was a favourite edible with freemen, and in sufficient plenty to be an article of food for slaves. The ancient Germans likewise cultivated the species of Brassica from very remote times; whether they, too, were indebted to their Roman conquerors for its introduction it is impossible to decide. The Saxon name for February is sprout-kale,* and that is the season when the sprouts from the old stalks begin to be fit for use: the Saxons must therefore, of course, have been familiar with the culture of cabbage or kale, as it is not at all probable that they invented the name after their settlement in this country.

The variety of brassica which was first cultivated in England cannot be ascertained, since our ancestors had no distinctive name for the different kinds. Many improvements have been made in the cultivation of this vegetable, and many new varieties introduced by different individuals at comparatively recent dates.

The close-hearted variety, which is now more peculiarly called cabbage, was for many years imported into England from Holland. Sir Anthony Ashley first introduced its cultivation into this country, and made the

* White's 'History of Selborne.'

English independent of their neighbours for a supply. This planter of cabbages likewise rendered his name known by other deeds, less creditable to his character. It is related that he had a command at Cales (Cadiz), where he got much by rapine, especially from a lady who intrusted her jewels to his honour; whence the jest on him, that he got more by *Cales* than by *cale* and cabbage. There is said to be a cabbage at his feet, sculptured on his monument at Wimborne St. Giles, in Dorsetshire.* Although Sir Anthony Ashley introduced the cabbage, it does not appear to have become generally cultivated, for we continued to import the vegetable for many years. Ben Jonson, who wrote more than half a century afterwards, says, "He hath news from the Low Countries in cabbages."

It is recorded that cabbages were first introduced into the north of Scotland by the soldiers of Cromwell.† A country embroiled in internal hostilities might be supposed not to be in a very favourable state for the more extended cultivation of plants, the passions of the contending parties being too keenly roused to pay attention to improvements in those arts the progress of which more peculiarly belongs to a period of peace. But in the present case the fact is opposed to this conclusion; we learn that "Cromwell was a great promoter of agriculture and the useful branches of gardening, and that his soldiers introduced all the best improvements wherever they went."‡

The colonies of German fishermen from Cuxhaven and the adjacent places, which peopled the coasts of the central parts of the east of Scotland, are, however, supposed by some writers to have brought with them their national love of brassica, and to have introduced some species of those plants, at a period much anterior to that of the Commonwealth, to this part of Scotland, which is more peculiarly "the land of kale." There the cabbage and the open colewort are in equal favour, giving the

* Gough's 'British Topography,' vol. i. p. 133.

† 'Edin. Encyc.,' Art. Horticulture.

‡ Loud., 'Encyc. Gard.' p. 87.

name of kale to a soup of which they form the principal ingredients, the outside leaves and the stalks of the plants falling to the share of the cattle. The father of Burns was from Kincardineshire; and the poet alludes to the customs of that county in his humorous comparison of Kilmarnock to a cow.

"Now auld Kilmarnock cock thy tail
An' toss thy horns fu' cantie:
Nae mair thou'lt route o'er moor and dale,
Because thy fare is scanty;
For lapfu's large o' gospel kail
Shall fill thy crib in plenty;
An' runts o' grace the feck and wale,
No gi'en by way o' dainty,—
But ilka day."

The lapfu's allude to the outside leaves, and the *runts* to the portion of the stalk and centre from which the parts fit for culinary purposes have been removed; the latter especially were given as a dainty to the favourite milch-cows.

Many allusions in the old Scotch songs point to the fact of the country about Aberdeen abounding with this vegetable. In recommending the good fare of the country, the poet says,

"There's cauld *kail* in Aberdeen,
An' *castocks** in Stra'bogie."

The "kale brose o' auld Scotland" is celebrated to the same tune as the "roast beef of old England;" and though, with many of the ancient peculiarities of the people, it has fallen much into disuse, it is still considered a national dish.

All those kinds of cultivated *Brassicæ*, the leaves and flowers of which are eaten, belong to the species *B. olera-*

* Cabbage stems having the fibrous part peeled off, and the remainder softened by boiling. Before the introduction of the turnip into general use in Scotland, this medullary substance of the stalks of the brassica was very commonly eaten by the peasantry.

cea. This resolves itself into many varieties and endless sub-varieties, which, however, may be reduced to three classes, having their distinctive characters sufficiently marked for all practical purposes.

1*st class*.—CABBAGES, in which the leaves gather into what is called a head, and are blanched by their own compression. The green colour is always much more completely destroyed by this blanching than the red; and the smaller the tendency which the expanded leaves have to blue or purple, the more sweet and crisp will the head become.

Cabbages are propagated by seed, which is sown at the three seasons, spring, summer, and autumn, to obtain a supply in succession. The soil for the seed-beds should be light, and not very rich.

The plants, from seed sown in autumn, are finally transplanted in spring. Most generally the seedlings are pricked out from the seed-beds as soon as they have one or two leaves of an inch or two broad, into beds of good earth; thence they are transplanted into a rich soil, which should be well manured.

2*nd class*.—KALE or COLEWORT.—In these the leaves are expanded and coloured, with the exception of a small portion in the centre, which encloses the rudiments of the flowering stem. The plain-leaved colewort is now seldom found in English cultivation. BORECOLE, or curly-leaved colewort, *Brassica oleracea*, var. δ *sabellica*, very generally, however, finds a place in our gardens. The green borecole, or Scotch kale, and the purple or brown borecole, are the most hardy of the race, and are therefore best adapted for cold situations and late seasons. The plants, when vegetating in a rich soil grow vigorously, and attain to large dimensions; but, in common with most of the genus, moderate-sized plants are best for culinary purposes, the very large being harsh, and those which are so small as to be stunted are bitter.

Sauerkraut, "that excellent preparation" of the Germans, and of which they are so immoderately fond, is

Colewort (*Brassica oleracea*).

merely fermented cabbage. To prepare this, closely-headed white cabbages are cut in shreds, and placed in a four-inch layer in a cask; this is strewed with salt, unground pepper, and a small quantity of salad oil; a man with clean wooden shoes then gets into the cask, and treads the whole together till it is well mixed and compact. Another layer is then added, which is again trod down, and so on until the cask is entirely filled. The whole is then subjected to heavy pressure and allowed to ferment; when the fermentation has subsided, the barrels in which it is prepared are closed up, and it is preserved for use. The preparing of sauerkraut is considered of so much importance as to form a separate profession, which is principally engrossed by the Tyrolese. The operation of shredding the cabbage is now performed by a machine, which the men carry on their backs from house to house; this means for the abridgment of labour has not been invented more than ten or twelve years. Every German family stores up, according to its size, one or more large casks of this vegetable preparation. October and November are the busy months for the work, and huge white pyramids of cabbage are seen crowding the markets; while in every court and yard into which an accidental peep is obtained, all is bustle and activity in the concocting of this national food, and the baskets piled with shredded cabbage resemble "mountains of green-tinged froth or syllabub."

Sauerkraut has been found of sovereign efficacy as a preservative from scurvy during long voyages; it was for many years used in our navy for this purpose, until displaced by lemon-juice, which is equally a specific, while it is not so bulky an article for store.

The larger and grosser kinds of cabbage are used as food for cattle. But this nutriment has a great tendency to impart a disagreeable flavour to the milk of cows fed on it, and even to the flesh of other cattle. This unpleasant effect may, we are told, be prevented by removing the withered leaves; but cabbage is more disposed to fermentation and putrefaction then almost any other vegetable. When cultivated as food for stock, it is of

course a matter of importance with agriculturists to produce the greatest weight in a given space. The average crop, as stated by Mr. Arthur Young, is thirty-six tons per acre, when the plants are grown on a dry soil, which is very similar to that quoted from other and more modern writers; but on a sandy soil only eighteen tons have been obtained. Some cabbages are occasionally produced of an astonishing size and weight. A cabbage-seed accidentally sown among onions came up in the onion bed, and, without any care being taken of it, grew to very large dimensions, and weighed, when taken up, twenty-five pounds. A cabbage was also produced in Devonshire, two or three years back, which, when growing, occupied a space of fifteen feet of ground, measured five feet in circumference, and weighed sixty pounds.*

A variety of brassica under the name of cow-cabbage (*Brassica oleracea*, var. *arborescens*) has been recently introduced into this country from La Vendée by the Comte de Puysage. The proximity of this department to the ancient province of Anjou, and the description of the plant, leave no doubt of its identity with the Anjou cabbage, a very large variety described by Mill.† In 1827 thirty-six seeds‡ were divided among six agriculturists, for the purpose of raising this useful vegetable in England. The perfect success resulting from some of these seeds, which have produced plants of a luxuriant growth, is already known; and horticulture is now so much more disseminated and understood in this country, that there is every reason to hope that the cow-cabbage will at length become naturalised in England. It is said that sixty plants afford provender sufficient for one cow during three or four years, without fresh planting. A square of sixty feet will contain two hundred and fifty-six plants four feet apart from each other, sixteen plants more than four cows require for a year's provender without the aid of other food. This plant is now successfully

* 'Gard. Mag.,' vol. iii. p. 351.
† Mill's 'Husbandry,' vol. iii.
‡ 'Gard. Mag.,' vols. iii. and v.

cultivated in Jersey, whence seeds have been sent to a nurseryman in London.

3rd class.—This division consists of cauliflowers and brocoli, which have the flowering stem short and succulent, the rudiments of the flowers forming into a curd-like head, which is not higher than the leaves, and becomes a mass of matter before the corolla or any other part of the flower is developed. This is the part of the plant used in this state as an esculent, but at the commencement of the development of the flowers it becomes bitter, and is no longer considered edible.

The CAULIFLOWER (*Brassica oleracea*, var. *botrytis*) is the most delicate variety of the genus brassica. It was first brought into England from the island of Cyprus, where it is said to attain to a high perfection, although it is not supposed to be indigenous to that country. The exact period of the introduction of this plant into English horticulture is not known; but it was certainly cultivated in this country at the beginning of the seventeenth century, although as a rarity which could only be produced at the tables of the most opulent. In the year 1619 two cauliflowers cost three shillings, the price of wheat being at that time 35*s.* 4*d.* per quarter.* It was not, however, until the latter end of the same century that this vegetable was brought to any degree of perfection; at least it was not raised in sufficient abundance to appear in our English markets until that period. The importation then of Dutch gardeners and Dutch gardening gave an impulse to English horticulture, which had been in rather a languishing state during the intestine troubles to which the Revolution of 1688 put a termination. But although the Dutch gardening no doubt produced an improvement in the cultivation of the cauliflower, as well as in vegetables generally, this plant became more naturalised in England than in Holland, or any of the adjacent countries of the Continent. Up to the period of the French revolution, cauliflowers were regularly exported from England into

* Eden's 'History of the Poor,' vol. i. p. 152.

Holland, some parts of Germany, and even France; and while the seed of very many cultivated plants is in this country preferred when it is of Dutch, rather than of English produce, cauliflower seed obtained from England is the most esteemed in Holland, and indeed throughout the Continent. The superiority of the English cauliflower is to be attributed solely to culture, and to culture carried on in the vicinity of London, not by experimentalists or amateurs, but by those who rear the plants for sale in the way of ordinary business. This vegetable is now cultivated very generally throughout the island; but since the portion of the plant which is used as food is not nearly as large as that of the cabbage, occupying an equal space, while it requires a richer soil and a warmer situation, it evidently can never become so cheap an esculent. Its delicate flavour is, however, in general much preferred to that of the cabbage, and it takes a higher rank in the list of culinary vegetables. Dr. Johnson, whose most trivial and perhaps sometimes absurd remarks have been considered worthy of record, used to say, "Of all flowers I like the *cauliflower* the best."

This plant, like the common cabbage, is first raised in a seed-bed of light earth, and finally transplanted into soil which can scarcely be either naturally or artificially too rich. The seed is generally sown at the latter end of the months of February, May, and August, for three succeeding crops. The plants raised from seed sown in the latter month stand through the winter, during which season and the first part of spring they are usually protected under hand-glasses. In the neighbourhood of London it is not uncommon to see whole acres overspread with such glasses, fostering an early supply of this vegetable for the inhabitants of the metropolis, and conveying to the mind of the beholder a forcible idea of the riches and luxury of this vast city.

The head of the cauliflower is not nearly so liable to putrescency, after being cut, as its leaves, which in this respect are similar to those of the cabbage. For a considerable time after the leaves have become flaccid and in a state of decay, the head remains unchanged, and

with care may be preserved without putrefaction for some months. By merely drawing up the plants entire, and hanging them in a cellar, they will continue in a sound state for a considerable time. The method most successfully adopted in Scotland, is to place the plants in layers in a pit, with their heads inclining downwards. The pit is then covered up closely with earth, beaten down, and smoothed in a sloping direction, so as to exclude both the rain and the atmosphere.

Brocoli is usually considered as merely a sub-variety of cauliflower, and that this is the case is rendered very probable from the great tendency of the plant to run into new varieties, which are constantly making their appearance, and as rapidly vanishing and giving place to others. It is a matter of common observation, that the more any plant has been changed by culture, the more readily does it admit of other changes.

But a few years back, only two sorts of brocoli were recognised—the red and the purple, both of which originally came to us from Italy. Thirteen varieties are now enumerated as raised in the English garden, and each in turn is recommended to the notice of the cultivator by some characteristic quality. In the culture of no vegetable has so marked and rapid an improvement taken place as in that of brocoli; horticulturists have recently succeeded in producing a hardy white variety, which has a handsomer appearance than either the green or the purple, while it is more delicate in flavour. White as well as purple are now obtained throughout the winter, some attaining to the size and equalling the cauliflower in appearance, though not in taste. The earliest spring crop follows without an interval the late winter crop, and no cessation need take place in the supply of brocoli, although, perhaps, it is not commonly raised during a month or two in the middle of the summer, when many other vegetables are produced in abundance.

Brocoli succeeds best in a fresh loamy soil; the seed-beds should be of rich mould, on which the seeds are thinly scattered, and covered with mats or litter till the plants appear.

The species of SPINACEOUS PLANTS, as they are called after the common spinach, are most generally of a softer texture and more insipid flavour than those of the brassica. As their excellence consists in the succulence of the leaves, a rich soil is required for their cultivation. They generally belong to the family *Chenopodeæ*,* having very small flowers of a greenish tinge, formed into heads of various shapes, as a ball, a bunch, or a spike.

Spinach (*Spinacia oleracea*).

SPINACH (*Spinacia oleracea*). The native country of the common spinach, and the time of its introduction into Britain, are not precisely known.

The west of Asia is assigned as its native country, but on what grounds is not very clearly shown, except that the earliest notice we find of it is in the works of the Arabian physicians, who of course only treat of its sup-

* De Candolle.

posed medicinal properties, which might probably have originally led to its adoption as an edible vegetable. Spain is supposed to have been the first European country into which it was introduced, for many of the old botanists call it *olus Hispanicum*; while some writers, among whom is Ruellius, distinguish it as *Atriplex hispaniensis*, and the latter adds that the Moors call it *hispanach* or *Spanish plant*. According to Beckmann, the first notice of its being used as an edible substance in Europe occurs in the year 1351, in a list of the different vegetables consumed by the monks on fast days: at that time it was written *spinargium* or *spinachium*. This plant found a place among culinary vegetables at rather an early period in England, for Turner, who wrote in 1568, mentions it as being at that time in common cultivation, and prepared for the table precisely in the same manner as it is at present.

Spinach is an annual plant, having large and succulent leaves: the flowering stems, which are hollow and branched, rise to the height of two or three feet. The male flowers grow on different plants to those of the female, which yield the seed. The former are produced in long terminal spikes, and the latter in close branches at the joints of the stem, or in the axillæ of the leaves and branches. This plant is remarkable as being one of the plants which are *diœcious*, that is, having the different parts of fructification upon separate plants. Some trees which are cultivated for their fruit, such as the date-palms, have the same peculiarity.

Two varieties of spinach are cultivated. The leaves of the one are arrow shaped and rough, and of the other round and smooth. July and August are the months in which the seeds of both kinds would naturally come to maturity; but as they slightly differ in their qualities, it is found more advantageous to sow them at different seasons. The round-leaved grows the fastest, is the largest and most succulent, and therefore is sown for succession crops in spring and summer; the other, being much more hardy, is preferred for winter supply. The former

is usually sown in January, from which time until the end of July frequent sowings are made for a regular succession, from the beginning of April to continue throughout the summer. The rough-leaved is usually sown in August for a winter crop. The seed is sown broad-cast, and in subsequent culture the plants are thinned first to three inches apart, and as they increase in size that distance is doubled.

From the circumstance of the male and female flowers growing on different plants, when they are left to bring their seed to maturity care is taken that a due proportion of each is suffered to remain. As soon as the seed capsules are set, the male plants are pulled up, thus allowing a freer space for the female plants wherein to perfect their seeds.

Wild Spinach, or English Mercury, or Good King Harry (*Chenopodium bonus Henricus*). This plant, which has obtained so many names, grows wild on a loamy soil, and may be found on way-sides and among ruins in many parts of England. The stalks rise to the height of a foot and a half; they are upright, thick, and striated, and covered with a whitish powder, which is likewise found on the under side of the leaves. These are arrow-shaped, and rather large for the size of the plant. The flowers, of a yellowish green colour, grow upon close spikes; they appear in June and July, and in August the seeds come to maturity. This plant is a perennial, and may be propagated by seeds or by offsets from the root. When young, both the stem and the leaves are succulent, the former being used as asparagus, and the latter as spinach.

Lincolnshire is the part of England where it is most in request, and where it is cultivated and preferred to the common spinach. It is, however, more nearly in a state of nature than the latter plant, and therefore cannot accommodate itself to differences of soil and situation.

The superior docility of a plant which has been long under cultivation, and which has travelled or borne changes of soil and climate in a growing state, is very apparent to those who attempt to rear wild plants in

situations where they are not indigenous. This fact is so important a feature in the natural history of plants, that it is not perhaps sufficiently pointed out or explained in books treating on these subjects. It is a very natural result, which on consideration should not excite surprise, that a wild plant, which has been from time immemorial produced on the same spot, and has there accommodated itself solely to the circumstances of that spot, should refuse to grow in any other situation where the circumstances are not precisely similar. It is upon this principle that the mountain berry will not flourish upon the champaign country, and that the sweetest flowers of the woodlands refuse their odour to the parterre. In like manner, "Good King Harry," which makes a very estimable spinach or asparagus in its native country, might make but a very sorry one if removed to a place where it is not indigenous.

New Zealand Spinach (*Tetragonia expansa*), so called because it was found growing wild on the shores of New Zealand when Captain Cook first touched at that island. Although the natives made no use of this plant as an esculent, the naturalists who accompanied the expedition were induced to recommend it as a vegetable which might be safely eaten, since its appearance and general characteristics were so similar to the *Chenopodium*. On trial, it was found to be both agreeable and wholesome. Sir Joseph Banks brought it into culture in England in 1772, and it has subsequently been found to be a much more hardy and valuable plant than was at first supposed. It was at first treated as a greenhouse plant; but now grows freely in the open garden, and indeed seems already to have naturalized itself in the south-west of England. A writer, from Exmouth, observes, in the 'Gardener's Magazine' for February, 1829, "The New Zealand spinach is quite a weed with us, as, wherever it has once grown, plants rise spontaneously, even when the seeds have been wheeled out with the dung in the winter, and again brought in as manure in the spring. I have now a full supply of it in my old pink bed." This spinach has an advantage over

the common sort under cultivation, in producing an abundance of large and succulent leaves during the hot weather, when the latter plant runs almost immediately to seed, and produces little or nothing. It is likewise milder in flavour, and of so rapid growth, that a bed with about twenty plants is sufficient for the daily supply of a large family.

New Zealand Spinach (*Tetragonia expansa*).

Though by some called a biennial, this spinach is an annual in our climate. The stem has numerous thick and strong branches, somewhat procumbent for the greater part of their length, but raised at the points. The leaves are fleshy and succulent, three or four inches long, of a dark green on the under part, but of a paler colour on the surface, on which the mid-ribs and nerves are strongly marked. They are triangular, or rather of an elongated heart-shape, having the angles at the base rounded, and the apex sharp and extended. The flowers are small, and of a yellowish green colour, they appear

in August and September. The whole plant is thickly studded with minute aqueous tubercles; a peculiarity likewise to be found in some species of *Atriplex* and *Chenopodium*.

In six weeks after sowing, some of the leaves of the plants are fit for gathering. These are pinched off, and not torn from the branches.

This plant has been likewise found growing on the Tonga Islands; and Thunberg discovered it of spontaneous growth in Japan.*

New Zealand spinach is remarkable as being almost the only native of the isles of Australasia which has been found worthy of a place in the kitchen-gardens of Europe.

Asparaginous Plants.—The ancients were accustomed to class all young sprouts of vegetables under the general name of asparagus. In agreement with this arrangement, all those pulpy shoots, stems, buds, and bottoms of compound flowers, which undergo culinary preparation before they become auxiliary articles of food, will be here designated as asparaginous plants.

The nature of this class of vegetables causes them to be always of more expensive cultivation than other plants the leaves or roots of which are used as esculents. For it is only a comparatively small portion of the whole plant which is here appropriated; and that too, most generally, when in a young and undeveloped state. Asparaginous plants must, therefore, always belong to luxurious, rather than to economic management.

Asparagus (*Asparagus officinalis*), a plant belonging to the natural order *Liliaceæ*, stands foremost in this list, as having been of most ancient cultivation, and as being most esteemed in every age. It was held in much favour by the Grecians, and is handed down to us by its present name in the writings of Dioscorides.† The Romans must have been particularly skilful in its cultivation, since, according to Pliny, three shoots of that grown in Ravenna weighed a pound, which is considerably more than the weight of the largest English asparagus.

* 'Hort. Trans.,' vol. iv. † Lib. ii. cap. 151.

Asparagus has a perennial root and annual stalks. The root is fleshy and succulent, composed of round knobs, which are united together into a kind of tuber. This is seated deep in the ground, and is not liable to be much affected by the winter frosts. From this root, which contains turions or eyes somewhat analogous to those on the tuber of the potato, the stems rise up in the early part of the spring, and are cut for use when only a few inches above the ground. There are few subjects in vegetable anatomy which display more beauty in their structure than may be disclosed in a transverse section of a head of asparagus. The shoot of an asparagus grows only from the extremity, and works or vegetates from the centre, and not from the surface, as in trees. Thus it pushes up through the soil *en masse*, if it may be so expressed. The branches, which lie so thick together, safe and well protected under their scaly leaves, soon begin to be developed, and are drawn out until the whole plant, with its numerous thread-like leaves, assumes very much the character of a larch tree, having its miniature parts more light and elegant, and the colour of a more lively green. The flowers, which wave in graceful panicles, are of a yellow hue, and of a fragrant smell. They are followed by round berries of a bright orange red.

The head of the young shoot of asparagus is edible just as far as the part which is to flower extends; and thus one who eats a head of asparagus eats in that little space the rudiments of many hundreds of branches and many thousands of leaves.

Asparagus is distinguished into two varieties, the red and the green: the first is a larger kind, growing fuller and closer, though handsomer in appearance, it is not considered of so good a flavour as the green. In consequence of its being more showy, it is, however, held in great esteem with market-gardeners. This kind has been cultivated with great success in soils consisting of little else than sea-sand, dressed annually with sea-weed; and by attending to this mode of culture it is probable that asparagus might be reared on many spots on the coast, that will hardly produce any other vegetable.

A large quantity of asparagus is raised for the London market. Battersea, Mortlake, and Deptford, at each of which places the soil is light and friable, are the chief localities for its cultivation. The breadth of land in asparagus-beds in the parish of Mortlake alone, is estimated to be nearly a hundred acres; one of the principal growers having sometimes forty acres under this crop. The largest cultivator in Deptford has eighty acres entirely laid out in asparagus beds.

Although the natural soil of this plant is poor and light, beds for asparagus can never be too highly manured, since its good quality depends on the quickness of its growth, which is accelerated by richness of soil. It is propagated by seed, which is sown broad-cast in spring; and at the same period of the ensuing year the young plants are transplanted to beds prepared for their reception, and where they are allowed to remain three or four years, before the tender shoots are cut for use. When these are from two to four inches above the ground, they are cut two or three inches below the surface. In cutting, care is taken to leave to each plantule or stool one or two shoots, to grow up into flower and seed, or otherwise the roots would perish. Under good culture, the same plants will continue to furnish annual crops during twelve or fourteen years. It is estimated by a practical gardener that five square poles of ground, planted with sixteen hundred plants, will yield, during the season, from six to eight score heads daily.*

Asparagus contains but little nutriment, but it is a mild vegetable, and pleasant to the taste. Though this plant is much cultivated in places where the luxuries of horticulture are abundant, its use is little known in situations remote from populous towns; of this the following anecdote will serve as an illustration:—About the close of the last century the proprietor of a considerable estate in one of the midland counties of Scotland, who prided himself upon his general knowledge and uniform

* Abercrombie.'

consistency, had passed the meridian of life without ever having seen asparagus. When he did at length meet with some at a dinner in a neighbouring town, he selected the white end, and having with some difficulty cut off a piece, he subjected it to rather a laborious process of mastication. A gentle hint was given that he had taken the wrong end; but disliking to confess ignorance in the matter, he assured the company that he always ate asparagus in that fashion, and for the sake of consistency he continued to gnaw the hard end as long as he lived.

Asparagus contains a peculiar vegetable principle to which the name of *asparagin* has been given, and to which, in part in least, the plant owes its qualities.

Sea-Kale (*Crambe maritima*), like the cabbage, belongs to the natural order *Crucifer*æ. In the first volume of the Transactions of the Horticultural Society, it is stated by Maher, that sea-kale was sent from England to the Continent by L'Obel and Turner, before the middle of the sixteenth century. No professional account of it, however, appeared for nearly a century after that period; the earliest notice being that taken of it by Miller, in 1731; and it was not until the year 1767 that it was first brought by Dr. Lettsom into fashionable repute as a garden vegetable. Since that time it has gradually come into very general culture in Britain, though, for the same reason as has been assigned in the case of asparagus, it can never become a cheap vegetable.

The cultivation of this plant is but little attended to, and apparently not very well understood on the Continent. In the 'Manuel du Jardinier,' for 1807, a French horticulturist described the *chou marin d'Angleterre*, but he was not aware of its proper application as an esculent, since he used the broad green leaves instead of the blanched shoots. This of course proved no very tempting preparation, and caused the plant to be condemned as only fit for the coarser tastes of the inhabitants of colder climates.

Sea-kale is a hardy perennial, and when allowed to

attain its full growth is a very beautiful plant. It is of a delicate sea-green colour, with a tinge of purple, and is powdered over with a very fine meal or bloom. The radical leaves are large, of a rounded form, waved, and deeply notched at the edges, and having very thick foot-stalks and mid-ribs. The flowering head is much branched; the single flowers are of a beautiful white, and have a rich odour of honey. They are followed by roundish pods, having two cells, one of which generally contains a seed, and the other is abortive. Notwithstanding which, however, the number of flowers upon one plant is so great as always to produce an abundance of seed. The shoots proceed from eyes on the roots, or from buds in the axillæ of the radical leaves; if these leaves are removed, and the flowering stems, as soon as they begin to appear, are cut, the number of the shoots and the rapidity of their growth are increased. This is an effect very desirable to be attained, since these shoots when young and tender, and the stalks of the unfolding leaves when blanched either by natural or artificial culture, are the parts used as an edible substance in the manner of asparagus. The peeled mid-rib of the large leaves which have been allowed to expand, after the plants have ceased to send up young shoots, is sometimes applied to the same purpose.

As the roots of sea-kale are perennial, and contain eyes or buds, the plant may be propagated either by sowing the seeds or parting the roots. Either of these methods may be advantageously pursued in the middle of the spring.

A deep light soil is so essential to this culture, that if the earth do not naturally contain sand, as much of this must be mixed with it as will ensure a drainage to the depth of at least two feet and a half. Water stagnating in any part of the soil to which the roots may reach, is found injurious to the plants.

The well-known nature and peculiarity of the soil and situation in which sea-kale is found point out the mode of its artificial culture much more clearly than is the case with plants of which the natural habits and

localities are not so well ascertained. This culture, therefore, is similar in its circumstances, except in that of time, to those which attend the growth of the plant when in a state of nature. The soil is made light and porous, and as the young plants advance they are artificially, if not naturally, watered. When the leaves of the first year die down, the beds are covered with a thin layer of very light and sandy mould, and over that with a layer of about six inches of light litter, to protect the plants from frost, and to preserve about the same temperature which the soil has during winter upon a light sandy beach. In the second season nearly the same treatment is pursued, the object being not to force the upward production, but to make the roots as full of germs and as strong as possible. The earthing up in those two seasons changes the bud in the axillæ of the radical leaves into germs, which will produce shoots in the ensuing year; and, as the process continues, the buds of one season become the stems of the next.

When the shoots of the third year are coming into action, preparations are made for obtaining the first crop. For this purpose a layer of about an inch thick of fine sand or gravel is laid on the sea-kale bed, that it may have a still nearer resemblance to the sea-beach. If the plants were left to their natural action in that soil, freely exposed to the air and the heat of the sun, they would come into flower in May or June, and the progress of the flowering stems, and the expanding and colouring of the radical leaves, would be so rapid, that the plants would be esculent only when very small, and would in consequence be of little value; they would not, in fact, differ much from the wild plants which the peasants gather upon the beach, being perhaps inferior, if the temperature were warmer than it is in those situations which are refreshed by the immediate presence of the sea.

This, therefore, is the point at which the skill of the cultivator changes the season of the plant, not by forcing it forward into productiveness, as is the case with fruits that are forced, but by checking its upward growth, and

causing the nourishment which would be thus expended to be directed to the enlargement of the shoots previous to their expansion. To produce this effect, as well as to blanch and prevent them from becoming bitter, the plants are covered with pots, so pressed down into the soil as to preclude the admission of light and the circulation of air, as both are detrimental to the colour and flavour of the produce.

Pursuing this method shoots are produced fit for use generally in April or May, and a succession may be obtained during six weeks. No plant is more easily and cheaply forced than sea-kale, and therefore a supply of this vegetable may be usually obtained for the tables of the affluent during mid-winter, and throughout those months when fresh vegetables are most difficult to be procured.*

The ARTICHOKE (*Cynara Scolymus*) belongs to the natural order *Compositæ*, and is a native of some of the warmer parts of the temperate zone, and is supposed to be indigenous to the countries which bound the Mediterranean, as well as to the islands which are situated in that sea.

Like sea-kale, it is naturally a maritime plant, or at least one which thrives best on soils where there is a mixture of saline or alkaline matter. It does not, however, flourish on the same sandy shore with the former plant, its most genial soil being that in which there is a mixture of peat or other decayed marshy vegetable matter. Nowhere does the artichoke arrive at greater perfection than in the Orkney Islands, and this successful culture is said to be consequent on the plentiful supply of sea-weed, with which the ground is annually dressed.

Beckmann made very laborious researches to ascertain the positive antiquity of the artichoke. These discussions are, however, more curious than interesting. A commentator of Dioscorides, Hermolaus Barbarus, who died in 1494, relates that this vegetable was first seen in

* London's 'Encyc. of Gard.,' p. 731.—*Abercrombie.*

the Venice garden in 1473, at which time it was very scarce. A few years previous to that time it was, however, an object of cultivation in other parts of Italy. It was introduced into France at the beginning of the sixteenth century, and not many years afterwards, during the reign of Henry VIII., was first transplanted into our gardens. In the Privy-Purse expenses of this king we find several entries regarding artichokes. Thus:—"Paied to a servant of maister Treasorer in rewarde for bringing Archecokks to the king's grace to Yorke place, iiijs. iiijd."—A treatise, written in the reign of Mary, on "the best settynge and keepynge of artichokes," is still preserved in the Harleian library, of which it forms the 645th number. Though in very common culture in this country, this plant is not held in so much estimation here as on the Continent.

The artichoke has large thick perennial roots and annual stems, rising to three feet or more in height. The leaves are large and pinnatifid, or cut in deep, horizontal, convex segments; these are covered with an ash-coloured down. In the midst of them rise the upright stalks, which are surmounted by large, scaly heads, composed of an involucrum, having numerous oval leaves or scales, enclosing the florets, and placed on a broad, fleshy receptacle; this, and the lower part or *talus* of the scales, are the only edible portions of the plant used in the early stage of their growth, before the central leaves of the calyx are separated, or the flowers in any way exposed. A large portion of the centre is occupied by what is vulgarly called the choke, which consists of the young flowers and seed-down, having the appearance of bristles or prickly filaments, and from which the receptacle, or bottom, must be entirely freed before it can be eaten.

Artichokes are most readily propagated by offsets from the roots of the old plants, from which they may be separated, and planted out anew in March or April, when they have attained a height of about five inches. They will produce a crop the same year, but not an abundant one, commencing in August, and continuing

till November; the second year they will be in full bearing, and produce two months earlier. Thus by planting fresh offsets every year, a succession of artichokes may be obtained from June to November. The old plants, however, will continue productive for many years, provided the ground be annually manured at the winter dressing. But although the heads may be obtained from roots twenty years old, they degenerate in size and abundance with the age of the plant, and therefore it is advisable often to renew the plantation.

The CARDOON (*Cynara cardunculus*) is also a compositous plant, and is a native of Candia, whence it was not introduced into England until more than a century after the artichoke. Its cultivation has never, however, been an object of much attention in Britain, where it is considered of little value. On the Continent this vegetable takes a higher rank, and is much more extensively used.

The stems of the young leaves, rendered mild and crisp by blanching, are the only edible part of the plant; these are stewed or used as an ingredient in soups and in salads.

The cardoon very much resembles the artichoke in appearance; but it is of a larger and more regular growth.

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